This is a digital copy of a book that was preserved for generations on library shelves before it was carefully scanned by Google as part of a project to make the world's books discoverable online.

It has survived long enough for the copyright to expire and the book to enter the public domain. A public domain book is one that was never subject to copyright or whose legal copyright term has expired. Whether a book is in the public domain may vary country to country. Public domain books are our gateways to the past, representing a wealth of history, culture and knowledge that's often difficult to discover.

Marks, notations and other marginalia present in the original volume will appear in this file - a reminder of this book's long journey from the publisher to a library and finally to you.

Usage guidelines

Google is proud to partner with libraries to digitize public domain materials and make them widely accessible. Public domain books belong to the public and we are merely their custodians. Nevertheless, this work is expensive, so in order to keep providing this resource, we have taken steps to prevent abuse by commercial parties, including placing technical restrictions on automated querying.

We also ask that you:

+ *Make non-commercial use of the files* We designed Google Book Search for use by individuals, and we request that you use these files for personal, non-commercial purposes.

+ *Refrain from automated querying* Do not send automated queries of any sort to Google's system: If you are conducting research on machine translation, optical character recognition or other areas where access to a large amount of text is helpful, please contact us. We encourage the use of public domain materials for these purposes and may be able to help.

+ *Maintain attribution* The Google "watermark" you see on each file is essential for informing people about this project and helping them find additional materials through Google Book Search. Please do not remove it.

+ *Keep it legal* Whatever your use, remember that you are responsible for ensuring that what you are doing is legal. Do not assume that just because we believe a book is in the public domain for users in the United States, that the work is also in the public domain for users in other countries. Whether a book is still in copyright varies from country to country, and we can't offer guidance on whether any specific use of any specific book is allowed. Please do not assume that a book's appearance in Google Book Search means it can be used in any manner anywhere in the world. Copyright infringement liability can be quite severe.

About Google Book Search

Google's mission is to organize the world's information and to make it universally accessible and useful. Google Book Search helps readers discover the world's books while helping authors and publishers reach new audiences. You can search through the full text of this book on the web at `http://books.google.com/`

LANE MEDICAL LIBRARY STANFORD
2 45 0179 7964

LANE

MEDICAL LIBRARY

SEAL OF THE LELAND STANFORD JUNIOR UNIVERSITY
1885

LEVI COOPER LANE FUND

U.S.

DEPARTMENT OF AGRICULTURE.
SPECIAL REPORT—No. 34.

CONTAGIOUS DISEASES
OF
DOMESTICATED ANIMALS.

CONTINUATION OF INVESTIGATION

BY

DEPARTMENT OF AGRICULTURE.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1881.

Resolved by the Senate and House of Representatives of the United States of America in Congress assembled, That there be printed fifty thousand copies of special report number thirty-four of the Commissioner of Agriculture, containing the reports of the veterinary surgeons appointed to investigate diseases of swine and infectious and contagious diseases incident to other classes of domesticated animals, of which thirty thousand and three hundred copies shall be printed for the use of members of the House, twelve thousand copies for the use of members of the Senate, and seven thousand seven hundred copies for the use of the Commissioner of Agriculture.

Approved, February 14, 1881.

-6
:2
.881

TABLE OF CONTENTS.

Page.
INTRODUCTORY 7

INVESTIGATION OF SWINE PLAGUE:
    Report of Dr. D. E. Salmon 13
    Report of Dr. James Law 81
    Report of Dr. H. J. Detmers 153

INVESTIGATION OF FOWL CHOLERA:
    Report of Dr. D. E. Salmon 27

CONTAGIOUS PLEURO-PNEUMONIA:
    Second report of Dr. Charles P. Lyman 196
    Third report of Dr. Charles P. Lyman 268

MISCELLANEOUS PAPERS:
    Aphthous fever or foot-and-mouth disease 282
    Investigation of an outbreak of Texas cattle fever 291
    The etiology of charbon 298
    Anthrax fever; reports of Drs. McLean, Detmers, and Law 311
    Circular letter on the subject of fowl cholera 314
    Outbreak of anthrax in New Mexico 317
    Non-existence of foot-and-mouth disease in the West 319
    Extracts from letters of correspondents 321
    Report of privy council of Great Britain, 1880 327
    General condition of farm animals 329

8976

LIST OF ILLUSTRATIONS.

Page.

REPORT OF DR. D. E. SALMON:

Plates from I to X inclusive—Microscopic investigations of swine plague and fowl cholera.. 80

REPORT OF DR. JAMES LAW:

Plates from I to IX inclusive—Lesions of swine plague..................... 152

Microscopic investigations of swine plague.................................. 152

REPORT OF DR. H. J. DETMERS:

Plates from I to III inclusive—Lesions of swine plague.................... 194

Plates from IV to XI inclusive—Microscopic investigations of swine plague. 194

Figures II to VIII inclusive—Microscopic appearances of exudation, &c., in swine plague.. 194

BRONCHITIS IN CATTLE: By Prof. W. W. WILLIAMS:

Plates from I to V inclusive—Lesions and microscopical appearances in bronchitis of cattle.. 236

REPORT OF CHARLES P. LYMAN, F. R. C. V. S.:

Plates from I to VII inclusive—Lesions and microscopical appearances in contagious pleuro-pneumonia.. 276

FOOT-AND-MOUTH DISEASE:

Plate I—Appearance of mouth in epizootic aphtha......................... 282

TEXAS CATTLE FEVER: Report of Dr. H. J. DETMERS.

Plate I—Spleen of animal affected with Texas cattle fever................ 292

Plates I to III inclusive—Microscopic investigations of Texas cattle fever.. 296

INVESTIGATION OF DISEASES OF DOMESTICATED ANIMALS.

INTRODUCTORY.

In presenting this report, which is the third of a series of reports issued by the Department detailing the results of the experiments instituted and conducted for the purpose of determining the nature and cause of some of the more destructive infectious and contagious diseases incident to domesticated animals, and, if possible, to discover remedies or preventives for the same, a brief reference to the work accomplished during the year may not be considered out of place. This investigation was commenced four years ago, the first year without any means at my disposal for its proper prosecution. A preliminary examination showed the work to be of such great importance that Congress readily granted means for the inauguration of a thorough scientific investigation of some of the more destructive contagious diseases of farm animals. The ablest veterinary surgeons in the country were employed and have been kept as steadily at work as the means placed at my disposal would permit. Among the more prominent scientific gentlemen thus employed may be named Drs. Law, Detmers, Salmon, Lyman, and McLean. The line of work has recently taken a much wider range than heretofore, and it is gratifying to be able to state that the patient and careful investigations conducted by the gentlemen above named and others employed by the Department, have resulted in many important discoveries which must eventually result in greatly lessening the heavy annual losses occasioned by some of the more malignant and fatal diseases to which farm animals are subject. From information received from many widely separated localities it would seem that the reports heretofore issued by this Department have already proved of great value to the stock raisers of the country. This has been especially so as regards the results of the investigation of the disease now generally known as swine plague. During the past year this malady prevailed to a much less extent than for many years past, and in those localities where it had previously prevailed in its most fatal form it assumed such a mild type that it was often found difficult to secure virus of a sufficiently malignant character for inoculation purposes. This was especially the case in Illinois and North Carolina, the former being the most northern and the latter the most southern State in which the disease has heretofore proved most destructive. Dr. Salmon calls attention to the mild type of the disease as it prevailed in the South during the past year. Dr. Detmers states that the lack of malignant cases often interrupted or delayed the investigations conducted by him. Writing under date of the 12th of May last, he says that during all the past winter and up to the date of his letter he had experienced great difficulty in securing virus of a sufficiently malignant type to use in his experiments; that instead of malignant cases being the rule, as in previous years, it was now hard to find a case of really genuine malignant swine plague. In confirmation of this many correspondents of the Department write that since they have adopted and carefully observed the preventive measures recommended in these reports the disease has prevailed to a far less extent than formerly, and that the losses have been proportionately less.

Dr. Salmon has made some investigations of swine plague which appear to throw considerable light on the nature of the organism, *i. e.*, micrococcus, found in this disease, and its power of resisting the effects of natural agencies and antiseptics. He finds that so powerful an agent as chloride of zinc does not destroy the activity of the virus in solutions of one-fifth per cent. or weaker, even when mixed with it for one-half to one hour before it is used for inoculation. Experiments with the cultivated micrococcus indicate that to prevent its multiplication requires a solution containing at least 2 per cent. of carbolic acid, 2 per cent of borax, 1 per cent. of benzoic acid, one-third per cent. of sulphate of quinine or iodine, one-fifth per cent. of salicylic acid, and one-tenth per cent. of chloride of zinc. In the same way it was found to resist 140° F. for fifteen minutes, but was destroyed by 150° F. for the same length of time. He has confirmed the conclusions of previous observers that the virus is destroyed in a few days by putrefaction, and has made a number of experiments which indicate that thorough desiccation at ordinary temperatures has the same result.

The remainder of Dr. Salmon's investigations of this disease were devoted to a study of the nature of the organism found in the virus. Three outbreaks in different sections of the South were studied. Blood was obtained by thrusting vacuum tubes into the blood vessels of very sick animals, and breaking the fine points of these by pressure across the vascular walls. When full they were immediately sealed in the flame of a lamp. It was thus obtained free from contamination with atmospheric germs, and might be preserved pure till examined. From a study of this blood he concludes that the bacteria which multiply during the disease, and which are found in the virus, are spherical in form and united in chains and various shaped clusters, and that these never develop into rods or filaments. This bacterium seems to be identical with that observed by Méguin in the *mal rouge* of France.

Drs. Klein and Detmers both observed these micrococci, but the former for some reason considered them foreign to the disease and accepted a *bacillus* which developed in his cultivations as the true pathogenic agent; while the latter believes that the globular bodies are the germs of *bacilli*, and eventually develop into such rods. Dr. Salmon reviews these theories and concludes that the *bacilli* found by these gentlemen were septic forms introduced into the virus from the atmosphere, or from gangrenous organs of the sick animal. His reasons for this conclusion are: 1. The blood of pigs in the three different outbreaks contained no other organism than micrococci. 2. This blood when used for inoculation produced unmistakable cases of swine plague. 3. The blood of the inoculated animals was found to contain the same organism. 4. When preserved a considerable time without contamination with atmospheric germs, the blood of sick animals never contained rods, filaments, or cylindrical spores, as it would if the micrococci developed into such forms. 5. The micrococci have been recognized in the virus by *all* observers, while two out of four have not found the *bacilli*. 6. So far as known, bacillus spores do not multiply by fission and form zoogloea clusters, as these granules certainly do.

Dr. Salmon, in common with other observers, finds the disease produced by inoculation to be milder than the original, and all cultivations after the second lost their activity entirely, or produced very doubtful results. The micrococcus was carried through eight cultivations in test tubes, however, and when inoculated was still able to produce redness of the skin and plain eruption of papulæ. He thinks that a sufficiently plain connection has not yet been shown to exist between the bacteria and the pathogenic agent, and believes that inoculation experiments, unless followed by loss of appetite, eruption, and other noticeable symptoms and lesions of the disease, cannot be accepted as evidence on a point of such importance.

Dr. Salmon devoted a portion of his time to an investigation of fowl cholera. This investigation resulted in the discovery of many important facts touching the natural history of this destructive disease. As early as February last he was enabled to announce, through a circular issued by the Department, which will be found embodied in this report, certain very important discoveries relating to this malady, and to prescribe such rules and preventive measures as his discoveries warranted for the prevention of the disease in non-infected flocks, and for its eradication in flocks in which it existed. His discovery that the virus of this disease remains in a fixed form, and that the disease germs or bacteria are seldom, if ever, taken up by the air and carried to any considerable distance to produce the affection, warrants the belief that the contagion will hereafter be easily controlled. Since closing his report Dr. Salmon writes (April 19) that he has made additional experiments which decide the comparative value of benzoic, salicylic, and carbolic acids in destroying the virus of fowl cholera. These experiments proved that the insusceptibility to the disease is not due to the presence or absence of a chemical substance in the body, as has been supposed by the leading French scientists, and also that the exact degree of heat which destroys the infecting properties of the virus destroys the bacteria; hence he concludes that the virus and bacteria are identical.

Dr. Law's experiments with swine plague were undertaken with the view of determining how far the virus can be mitigated by artificial means, so that the disease may be made to assume a mild or harmless form, and how far such mitigated type of the malady will prove protection against the effect of a second exposure to infection. While the results of his experiments in the earliest stages of his investigation were not entirely satisfactory, yet they seemed to show that inoculation with the virus cultivated in certain organic solutions is attended with little danger to the animal, and produces a condition of the system which is protective against the dangers of a renewed exposure and also against the perils usually attending inoculation with a moderate amount of the ordinary or native virus. It was clearly shown in these experiments that the poison as cultivated in certain other organic mixtures becomes very deadly, that the virus that has been shut up for some time with a limited amount of air is no less so, and that the introduction into the system of a maximum dose of the more potent forms of the poison will defy all protective measures. Later experiments in inoculation were of a more decided character, and were of such a nature as to warrant Dr. Law in stating with much positiveness, first, that the virulence and fatality of the swine-plague germ is increased when grown in a very limited amount of air, and is decreased when cultivated in free air; second, that by placing the system of the animal under the influence of the chemical products of the growing swine-plague germ, though the germ itself is not introduced into the economy, the animal is rendered insusceptible to a future attack of the disease.

Dr. Detmers undertook a number of experiments for the purpose of determining the value of certain chemical compounds heretofore regarded as of some value as preventives of swine plague. In many of these experiments inoculations were made with malignant virus, followed by active treatment with such antiseptics as carbolic acid, benzoate and hyposulphite of soda, iodine, &c., with a view to the destruction of the injected poison. Of the various chemical compounds used Dr. Detmers gives his preference to that of carbolic acid. He is satisfied that the disease may be arrested, where no morbid changes have occurred, by the timely and proper use of this drug. The hygienic measures proposed by Dr. Detmers are worthy the careful study of those interested in the rearing of this class of farm animals.

The second and third reports of Dr. Charles P. Lyman, on the subject of contagious pleuro-pneumonia or bovine lung plague, will be read with interest by those engaged in the rearing of neat cattle for exportation. His second report gives a brief statement of his proceedings during his recent visit to England, to which is appended the contagious-diseases (animals) act of Great Britain, the orders of the privy council relating to the embargo of American cattle, and many other matters bearing upon this subject of interest to the general reader. In his third report will be found a detailed statement of the results of his investigations, which show that the American cattle condemned at Liverpool by order of the veterinary inspector of the privy council of Great Britain during his stay in that country were *not affected with contagious pleuro-pneumonia*, but *were suffering with a form of chronic interstitial pneumonia.*

Among additional important papers contained in this volume, to which the attention of the reader is directed, are the following: "Aphthous Fever or Foot-and-Mouth Disease"; Investigation of an outbreak of Texas Fever of cattle"; "The Etiology of Charbon"; reports of Drs. McLean, Detmers, and Law, on the character of an outbreak of disease among cattle in the States of Missouri, Iowa, Illinois, and New York; the report of Dr. McLean as to the condition of a number of herds of cattle examined by him in the West and Southwest, and the recent circular letter of Dr. Salmon on the subject of fowl cholera.

WM. G. LE DUC,
Commissioner of Agriculture.

INVESTIGATIONS OF SWINE PLAGUE AND FOWL CHOLERA.

Second Report of D. E. Salmon, D. V. M.

Hon. WM. G. LE DUC,
Commissioner of Agriculture :

SIR : I have the honor to submit the following report of investigations, undertaken by your authority, of the diseases known as the swine plague and fowl cholera.

PART I.—INVESTIGATIONS OF SWINE PLAGUE.

By the investigations carried out under your direction in 1878, many important and long-contested questions respecting this disease must be regarded as definitely settled. Among the more important of these I particularize the following, which had a controlling effect on my work during the past year. 1. The great epizoötics among swine in the West and South are the result of one and the same disease. 2. The symptoms and more apparent lesions of this are definitely ascertained. 3. This disease is contagious, and the great majority of cases may be traced to contagion. 4. It may be communicated by inoculation to other species of animals.

There were some other points, however, which still needed much investigation. Most important of all, from a practical stand-point, seemed the necessity of determining the comparative activity of different disinfectants in destroying the virus, in order that an intelligent selection of these might be made in freeing infected premises from the disease and possibly in the treatment of sick animals. It was, also, exceedingly desirable that further microscopic observations should be made with a view of obtaining more substantial evidence in regard to the nature of the contagious principle which constitutes the essential cause of the disease. For, if this disease could be traced to the effects of a microscopic organism with the same certainty as anthrax fever has been traced to the *Bactéridie* or *Bacillus anthracis*, we might be able to discover points in the development history of this which would have as great influence on our sanitary measures as the recent discoveries of Pasteur must have on the prevention of anthrax.

FIRST SERIES OF EXPERIMENTS.

The virus for these inoculations was obtained at Pickens, S. C., December 29, 1879, by killing a sick animal belonging to Mr. Hagood. The disease had prevailed for several weeks, and a few hogs from this gentleman's herd were already dead. Two were sick at the time of my visit. The one selected had been improving for about a week, had a fair appetite, but still went with arched back, tucked-up abdomen, and staggering walk. Temperature 103½° F. Traces of petechiæ and eruption on skin of abdomen and inner side of thighs. The abdomen was distended with a transparent yellowish effusion, in which coagulæ rapidly formed on exposure to the air. Small intestines slightly congested; peritoneum thickened; liver congested; small patches of hepatization in both lungs, and bronchial tubes filled with reddish froth. Mucous membrane of stomach considerably reddened in places; lymphatic glands congested; blood dark colored, but formed a firm coagulum. Vacuum tubes were filled with blood and abdominal effusion and hermetically sealed; pieces of lung, stomach, spleen, and lymphatic glands secured.

EFFECT OF SOLUTION OF CHLORIDE OF ZINC ON THE VIRUS.

In Professor Law's experiments, but one of the agents which he used seemed to be an efficient disinfectant, in solutions of one-fifth of 1 per cent. after a contact of five minutes. This was chloride of zinc.* To make a thorough test of the activity of this agent, and to discover the weakest solution that would prove a safe disinfectant, seven pigs were inoculated, January 3, 1880, as follows:

Experiment No. 1.—One pig inoculated with peritoneal effusion, blood and dried froth from trachea.

Experiment No. 2.—One pig inoculated with one drop of effusion in four of distilled water.

Experiment No. 3.—One pig inoculated with one drop of effusion in four of a solution of chloride of zinc 1:500.

Experiment No. 4.—One pig inoculated with one drop of effusion in four of a solution of chloride of zinc 1:1,000.

Experiment No. 5.—One pig inoculated with one drop of effusion in four of a solution of chloride of zinc 1:3,000.

Experiment No. 6.—One pig inoculated with one drop of effusion in four of a solution of chloride of zinc 1:4,000.

Experiment No. 7.—One pig inoculated with one drop of effusion in four of a solution of chloride of zinc 1:5,000.

Method of preparing the virus.—From one-half to one hour before using, four drops of the solution of chloride of zinc of the required strength were placed in a watch glass; to this was added and thoroughly mixed a single drop of peritoneal effusion. It was then covered with a small bell glass, and allowed to stand till used. In each case the solution had sufficient strength to coagulate the albuminoid constituents of the effusion, and thus produce a white liquid resembling milk. With the solution of 1:5,000 this was less marked than with the others, but still quite noticeable, and it was hoped from this demonstration of the activity of the diluted solution, that it might prove effective in destroying the virus when in contact with it for a considerable time. As we shall soon see, this hope was not realized.

Method of inoculation.—To prevent constant disinfection of the lancet, virus treated with the stronger solutions was first used, and the pure virus inoculated last; that is, the inoculations were made in the following order, according to the numbers of the above experiments: No. 3, 4, 5, 6, 7, 2, 1. Of course, if the virus were destroyed at all this would happen with the strongest solution, and the contamination of the lancet would, therefore, have no effect on the results. In each case the grooved lancet was used, one drop of virus being inserted in each of two punctures in the ear, and one drop in a single puncture on inside of thigh.

---

* *Report of* Commissioner of Agriculture, 1878, p. 378.

Distribution of animals.—The animals, numbered to correspond with experiments, were, for convenience in feeding, with one exception, placed two in each pen. Thus, Nos. 1 and 2 were placed in pen No. 2; Nos. 3 and 4 in pen No. 1; Nos. 5 and 6 in pen No. 3; and No. 7 in pen No. 4. The pens were at least 100 feet apart, and it was believed that, in case one of the inmates of a pen should contract the disease from the other, the difference in the time of appearance of the first symptoms would make this apparent.

Results.—Not one of these pigs escaped the infection. January 12, No. 1 had eruption; No. 2 was coughing; No. 4 coughing, with high temperature. January 15, all have a plain eruption, most noticeable on the inner sides of thighs and fore-legs. Temperature of No. 4 still high (104¼°), but that of No. 7, though covered with eruption, is but 98½°.

January 17.—No. 4 killed for examination. The skin covered with elevations of considerable size, and very apparent; granular melanotic deposits in the areolar tissue beneath abdomen; mesentery thickened, and intestines united as the result of peritonitis; elevations on mucous surface of duodenum; congested patch on mucous membrane of stomach; liver congested and softened; spleen reddened along its border, and somewhat mottled; lungs almost completely hepatized; bronchi filled with white froth; hyperæmia of nearly all the lymphatic glands.

These lesions can leave no doubt of the nature of the disease produced by the inoculation.

January 23.—No. 7 was killed, and presented equally plain lesions of swine plague.

January 31.—No. 1 was killed, and found to have lesions much less satisfactory than either of the others.*

The remaining animals were allowed to recover.

Conclusions.—There can be little doubt from the period of incubation and lesions, especially with Nos. 4 and 7, that the disease produced was a mild form of swine plague. We must conclude, therefore, that chloride of zinc in solutions of one-fifth per cent. and weaker, even when mixed with a small quantity of virus in liquid form for half an hour before inoculating does not destroy the disease-producing properties of this virus, and is, consequently, in no sense a disinfectant in solutions of such strengths.

SECOND SERIES OF EXPERIMENTS.—EFFECT OF PUTREFACTION ON VIRUS.

Everything pertaining to the destruction of the virus of contagious diseases by natural agencies is of great interest, since from such facts we are enabled to judge as to the time infected premises are unsafe, and also as to the state in which the virus is preserved, as seems to be the case for considerable periods of time even when exposed to the ordinary atmospheric changes. A number of experiments bearing on this point were, therefore, made as follows:

Experiment No. 8.—One pig was inoculated March 31, 1880, by two lancet punctures in the ear, in each of which was placed a single drop of the peritoneal effusion from the pig killed at Pickens, S. C., December 29, 1879, or 93 days before. This had been preserved in a loosely-corked bottle in a warm room, and had an exceedingly unpleasant odor. It produced no effect. May 3, this pig was reinoculated with the same liquid, now preserved 126 days. No effect, either local or general, followed the inoculation. Animal preserved for several months.

---

* Temperature record and fuller particulars are given in appendix to this report.

Experiment No. 9.—One pig was inoculated April 12, 1880, with pleural effusion from pig No. 7, killed January 23. This had been preserved in a hermetically-sealed capillary tube, but was considerably decomposed. It is to be remarked here that hermetically sealing virus in capillary tubes does not prevent its decomposition unless unusual precautions are taken to prevent the germs of bacteria from gaining access to it, either before or during the process of filling and sealing. Three lancet punctures were made in the ear and one in thigh, in each of which a drop was placed by means of the grooved lancet. Not the least effect either local or general followed.

Experiment No. 10.—April 6, 1880, Dr. Detmers mailed to me some pulmonal exudation of a pig that had died that morning, It was received April 12. Two quills had been filled with the liquid, and the ends closed with wax. It had a dark purple color, a plain odor of putrefaction and swarmed with *Bacterium termo*, but besides this organism there were many *Bacillus* rods about $\frac{1}{35000}$ of an inch in diameter, and of various lengths, and spherical and oval granules of a similar diameter, both single and in chains. Two hogs were at once inoculated by means of the grooved lancet, punctures being made both in the thigh and ear, and a drop inserted under the skin at each point. The animals were carefully watched for a month without observing the least symptom of disease.

Experiment No. 11.—May 4, Dr. Detmers mailed me cotton wool which had been previously saturated with pleural effusion and partly dried. It was received May 10, still moist and with a slight odor of decomposition. Two pigs were immediately inoculated, by forcing small pellets of this cotton under the skin with a lancet. The pellets were selected from different parts of the mass, some being from the driest parts while others were selected because still moist. One pig had six of these pellets inserted beneath the skin of the inside of the thighs; the other had two pellets in the ear, two at inside of fore legs, and one under abdomen. No sign of disease within the next six weeks.

Experiment No. 12.—The cotton remaining from above experiment was placed in a beaker and moistened with a weak solution of salt (three-fourths per cent.), and allowed to stand four hours, when the liquid was separated by pressure. This was of a reddish color, had a slightly unpleasant odor, and contained vast numbers of bacteria, among which could be plainly distinguished *Bacterium termo* and *Bacilli*, as in Experiment No. 10, with many globular elements singly and in both clusters and chains. One pig was inoculated by hypodermic injection of three cubic centimeters of this liquid at the inside of thigh. Remained in the best of health for the next six weeks.

Experiment No. 13.—June 3, I received from the same gentleman an hermetically-sealed glass tube containing virus in a liquid form. It had been on the way eight days, and was in an advanced stage of decomposition. One pig was inoculated by inserting three or four drops in a number of punctures with the lancet. No symptoms of disease could ever be detected, though the animal was preserved for two months.

Conclusion.—Putrefaction entirely destroys the virus of swine plague, and this may occur within six days in ordinary spring weather.

THIRD SERIES OF EXPERIMENTS.—EFFECT OF DRYING THE VIRUS.

Experiment No. 14.—Four pigs were inoculated May 3, with virus which had adhered to outside of capillary tubes when these were filled December 29. This, being in an extremely thin layer, dried rapidly and remained in a thoroughly dried condition. It was scraped off, slightly moistened with three-fourths per cent. salt solution, and inserted under the skin of ear and thigh with lancet. The pigs remained in good health for months afterwards.

Experiments No. 15.—One pig was inoculated May 5, 1880, with dried lung and intestine from pig killed in South Carolina, December 29. Small pieces of these organs had been thoroughly dried in the sun and preserved in a dry room; six small particles were pared from different parts and inserted hypodermically. No effect whatever was produced.

Experiment No. 16.—A single pig was inoculated June 3, by inserting a section of quill and three small pellets of cotton beneath the skin; both quill and cotton had been dipped into perfectly fresh virus, by Dr. Detmers, nine days before, and carefully dried.

June 15.—This pig has an eruption of pustules, one-fourth to three-fourths of an inch in diameter, under the abdomen and on inner side of legs. Some of the elevations have a small opening at the summit, from which pus escapes. Appetite good; temperature 103½° F.

June 22.—The animal killed by bleeding. There has been little change in appearance from that noted seven days ago. The elevations still exist, but are healing and few are discharging.

Post-mortem examination.—The peritoneal cavity contains about one-half pint of transparent, colorless liquid; the pleura and pericardium each contain one gill of a fluid of similar appearance. The intestines adhere quite firmly by newly-formed tissue. The lungs have many small indurated points throughout, probably the result of a former mild attack of the disease which this animal had in January. No other lesions were to be observed, except those plainly associated with the parasitic worms so common in this section, viz.: *Echinorynchus gigas*, *Stephanurus dentatus* and *Strongylus elongatus*.

Experiment No. 17.—The virus for this was obtained in Guilford county, North Carolina, from a hog killed the 1st of June. The outbreak of the disease in this county had extended over a section four or five miles square—a very large proportion of the hogs dying. There was effusion into the peritoneal and pleural cavities and also into the pericardium of the animal killed. The left lung was almost entirely hepatized. A small quantity of cotton wool was dipped into the pleural effusion and thoroughly dried in the air; this did not occupy one-half hour, and, consequently, there was no time for putrefaction. One pig was inoculated June 3 by forcing pellets of this cotton wool under the skin with a lancet. No effect whatever resulted.

A pig inoculated for comparison with pleural effusion preserved in a tube had dull appearance, cough, eruption of pustules and elevated temperature (104¼° F.) the twelfth day, but soon recovered.

Experiment No. 18.—Two pigs were inoculated July 12, 1880, by inserting two small pellets of cotton under the skin on inside of thigh. This cotton was prepared July 2, by moistening in the liquid which exuded from a section through the hepatized portion of a lung taken from a pig killed near Charlotte. It was immediately dried by spreading in a thin layer and exposing to a current of air. No effect whatever followed the inoculation.

In addition to these experiments, I sent virus to Professor James Law about the 1st of October, 1878. It was the liquid obtained by section of the hepatized lung of a pig in the first stages of the disease; quills were dipped into this and dried in the air. Professor Law succeeded in producing the disease with this virus five days later.

These experiments indicate that the virus thoroughly dried and preserved in this condition loses its activity in a few days. Professor Axe has published experiments which show that the dried virus may remain active for twenty-six days, and Professor Law has produced the disease with dried virus six days old. It is possible that in the moist climate of England the virus may retain its activity much longer than in America. In the above experiments the disease was induced in one case with virus nine days after drying, but it failed with one animal two days after drying, with two after ten days, and with five animals one hundred and twenty-five days after drying. It has been recently ascertained, also, that complete desiccation destroys the virus of glanders in fifteen days.[*]

These facts lead us to believe that the well-known disinfecting effects of free ventilation are due to the thorough desiccation of the virus; and they make it plain that this, the cheapest of all means of disinfection, should never be neglected in dealing with this class of diseases.

FOURTH SERIES OF EXPERIMENTS—INOCULATIONS WITH CULTIVATED VIRUS.

Experiment No. 19.—Virus which had been preserved ten weeks in a capillary tube hermetically sealed was cultivated for eight generations in urine. The method of cultivation was to fill a previously-heated test-tube half full of fresh urine, to this was added a few drops of the preserved liquid (peritoneal effusion), and the tube covered with sheet caoutchouc well tied down. The tube was kept in an incubator at 95° to 100° F., and in about twenty-four hours would become cloudy by multiplication of microscopic organisms, when another tube would be prepared in the same manner and inoculated from it.

April 7 the eighth generation was obtained and a single pig inoculated by hypodermic injection of twenty minims.

May 3 this animal had a plain eruption of papules with reddening of skin under the belly and on inner side of legs. The appetite was good and temperature but 101¾° F. The eruption and discoloration disappeared in a few days.

Experiment No. 20.—In a certain number of test-tubes, containing infusion of beef, which were placed in the incubator without addition of any kind, and merely for comparison with those to which virus had been added, spherical granules appeared which in size and appearance resembled the micrococci that I had observed in cultivations of virus. To test their pathogenic properties two pigs were inoculated, April 1, by hypodermic injection of fifteen drops each, of the infusion containing them. May 3 they presented considerable discoloration of skin and slight eruption very similar to that noted in the preceding experiment. There was at no time loss of appetite or any other symptom of illness.

Conclusions.—Though in the two experiments of this series the symptoms of swine plague were as plain as some investigators have considered necessary to determine the success of an experiment, I should certainly hesitate to conclude that this disease had really been induced in either case. A discoloration of the skin, a slight eruption, a little coughing or sneezing are symptoms which are frequently met with when swine plague cannot be suspicioned; and in matters of such great importance, which indeed influence our whole theory of the disease, it seems to me something more definite should be required. There can only be certainty when real sickness, with loss of appetite and the characteristic internal lesions, are produced.

Comptes Rendus, xci (1880), p. 476.

MICROSCOPIC INVESTIGATIONS IN REGARD TO THE NATURE OF THE VIRUS.

The great interest that is at present attached to the microscopic characters of the virus of contagious diseases as a class, and particularly to that of swine plague since the publication of the investigations of Doctors Klein and Detmers, led me to devote as much time and care to this method of research as could possibly be bestowed upon it without interfering with other duties. The lenses used were generally the one-tenth and one-fifteenth immersion of Tolles, combined with a 1½-inch eye-piece and giving 600 and 1,000 diameters respectively. A ¾-inch eye-piece which doubled these powers was occasionally used, but what was gained in amplification was lost in definition, so that as a rule the lower-power eye-piece gave the most satisfactory results.

As it is impossible to give a detailed account of all the observations made, since a dozen or more preparations were often examined in a single day, in each of which would be several hundred microscopic fields, I select those which combine the most important features. I have had no preconceived theory to bolster up by reporting such observations as supported it and rejecting those opposed; but, on the contrary, I have endeavored to present an unbiased *résumé* of what I have seen without regard to its influence on this or that particular theory.

While the pigs of the first series of experiments were sick, a considerable number of preparations of blood were made and examined. The blood was generally taken from the ear; the slides and cover glasses were always cleaned with great care and often passed through the flame of an alcohol lamp.

January 15 the blood of the pig in Experiment No. 4 was found to contain a vastly increased number of white globules (leucocytes), and besides these there were many granules varying in size from a mere point, as seen when magnified 1,000 diameters, to the size of the blood globules. They were apparently structureless, of irregular form, and motionless. They were, as near as could be ascertained, identical with granules frequently found in normal blood, and doubtless consist of fibrin.*

The blood of No. 1 was examined the next day (January 16), and was found to contain the same increase of the irregularly-formed granules, but without notable increase of leucocytes. Fig. 1 is a drawing made with a camera lucida of a part of a field in one of these preparations.

In the blood of the animal killed January 17 there were very many granules of a different character; they were of uniform size, spherical, $\frac{1}{30000}$th of an inch, or less, in diameter, and without motion. When perfectly fresh there were no *Bacilli* or other bacterial filaments to be found; but in a preparation kept a few days for further examination, a certain number of these appeared. Fig. 2 shows some of the forms which were thus developed; it also shows the multiplication of some of the *Bacillus* filaments by a process which has been overlooked by many investigators, viz: The formation of spherical granules from filaments by fission. Similar observations have also been made by Dr. T. R. Lewis.† The few filaments shown were the only ones in the preparation, and the short rods were by no means numerous. The spherical granules, however, existed in large number, as seen in Fig. 3.

---

* Ranvier, Traité Technique d'Histologie, p. 217.

† The Microphytes which have been found in the Blood and their Relation to Disease. Quart. Jour. Mic. Science, 1879, p. 393.

As soon as the pig killed January 31 was dead, I prepared several slides with the greatest care, and, after placing upon them some of the contents of the smaller bronchi, cemented down the cover glass with Canada balsam. One of these preparations still (October 15) presents the same appearance as when first examined. It contains great numbers of leucocytes of various sizes; some of these are breaking up into bright granules of similar appearance, but differing widely as to size, and which evidently consist of fat (Fig. 4, *a.*); but others are filled with uniform, apparently spherical, granules about $\frac{1}{30000}$th of an inch in diameter. In many cases the homogeneous connecting substance seems to have disappeared and the position of the leucocyte is only marked by a cluster of granules still near together and exactly resembling, in size, shape, form of cluster and general appearance, those in the still intact cells. In other cases the retrogression has gone still farther, and the granules are more or less scattered and now would be considered as micrococci (Fig. 4, *e*, *f*). Besides the globules and granules mentioned there was only a small number of cells from the mucous membrane lining the air-passages, and some globules varying in size, the nature of which could not be determined, but which were thought to be a form of oil. Though carefully examined with the one-fifteenth objective as soon as prepared, and several times since, I have never been able to find either a cylindrical *Bacillus* spore, a *Bacillus* filament, or anything resembling bacteria, with the exception of the granules already noted, which many would call micrococci.

Granules of similar size, and staining deeply with carmine, were observed in the inflammatory new formation on surface of kidney of the pig killed January 23 (Experiment No. 7).

At the time the Guilford county pig was slaughtered (see Experiment No. 17 above), four capillary vacuum tubes were filled with virus, as follows: The finely-drawn-out end of a tube was forced through the walls of the jugular vein, the extremity broken within the vessel, and the tube allowed to fill completely, when it was withdrawn and immediately sealed with the blow-pipe. Three other tubes were filled with pleural and peritoneal effusion, care being observed to plunge them deeply into the liquid before breaking the point, in order to avoid introduction of germs which might have fallen on the surface of the liquid.

When examined with the microscope two days later (June 3), these liquids were perfectly fresh—there was no escape of gas on breaking the tubes, no unpleasant odor, and the liquor sanguinis of the blood and the transparent effusions were free from any cloudiness, with the exception of one tube that had filled imperfectly. Putrefaction had, therefore, not commenced, and two days had been allowed for the development of such germs or organisms as were peculiar to the virus; if, then, the disease is caused by *Bacilli* or their germs, the developed filaments should be present in these tubes in much larger number than other bacteria forms.

Results of microscopic examination.—Tube No. 1, pleural effusion, contained many very small spherical granules (monococci); many couples of these (diplococci); a few chains of three to ten elements similar in appearance to the single granules (streptococci); a few chains and couples of oval elements $\frac{1}{40000}$th of an inch in short diameter by $\frac{1}{25000}$th of an inch in long diameter. A few *Bacilli* were present mostly as single rods, though one chain of these made up of six rods was seen, each of which was $\frac{1}{2000}$th of an inch in length; but not more than three or four of these filaments could be found in a preparation, and the majority of the fields contained none, though swarming with the mono and diplococci. Finally, many gliacoccus masses were to be seen made up of the spherical granules, the size of these clusters being sometimes twice the diameter of the red globules.

Tube No. 2; pleural effusion: This tube did not fill entirely, and had commenced to decompose. It contained many monococci and diplococci; a few *Bacterium termo* and some oval granules having the appearance of spores, but no rods.

Tube No. 3; peritoneal effusion: Many granules single and in couples as above, a few in chains; no *Bacilli*.

Tube No. 4; blood: This being the only tube that could be filled with absolute certainty of excluding atmospheric germs, much more weight should be placed upon the results of its examination than upon either of the others. It contained a considerable number of spherical granules, similar to those found in the other tubes, and something less than $\frac{1}{30000}$th of an inch in diameter; also some white particles $\frac{1}{20000}$th to $\frac{1}{12000}$th of an inch in diameter, irregularly round or elliptical—probably fibrin. No *Bacilli* nor cylindrical granules resembling their spores.

In the account of Experiment No. 16, the virus for which was obtained from Dr. Detmers, mention is made of an eruption of pustules occurring on the thinner parts of the skin of the inoculated animal. The pus from one of those was examined under the one-fifteenth objective, June 18. It contained, besides the pus globules, spherical granules about $\frac{1}{30000}$th of an inch in diameter, existing both singly and in couples, very uniform in size and appearance, and having a very lively molecular or Brownian motion. No other figured elements could be discovered.

When this animal was killed (June 22), capillary tubes were filled with the peritoneal effusion, and also with blood, by breaking the fine extremity within a vein. They were then immediately sealed and laid aside till convenient to examine. The effusion preserved in this manner and examined within two hours seemed to contain no definite figured elements. After two days a few spherical granules, similar to those found in the pus, were observed.

The blood, preserved two days, contained a considerable number of spherical granules of identical appearance. But here was noticed for the first time a phenomenon which seemed to merit particular attention. The granules existed for the most part near the clusters of leucocytes—some were upon or even within these; while surrounding the leucocytes and often embracing the granules could be made out a finely granular matter, which was evidently the protoplasm freed by partial disintegration of the corpuscle. Many of the leucocytes, indeed, had become so indistinct that it was difficult to make out their outline, and in other cases there was only the finely granular matter containing the larger granules, the corpuscles having entirely disappeared. Fig. 5 is a drawing made from a preparation of this blood.

Taking into consideration the gradations of disintegration observed, the presence of the granules near the clusters of leucocytes and even within them, and it seemed very probable that these granules were originally a constituent of the leucocytes, and that they escaped from these as a result of vital modifications occurring either before or after the death of the animal.

Such granules might, however, consist entirely of fat, and therefore be lifeless and incapable of reproduction; or they might be protoplasmic granules endowed with life, and capable of indefinite multiplication. Their uniform size indicates that they are not oil globules, and the fact that they are not dissolved by ether corroborates this view; but the ether test as generally applied by microscopists is not entirely reliable with particles of such small dimensions, and it is probable that their behavior towards the different staining agents will be found a more satisfactory method of determining their nature. My own investigations in this direction have been too few to give any safe basis for a decision; but the fact that granules that could not be distinguished from these in appearance multiplied enormously in some of my tubes of blood led me to consider these as living and capable of reproducing themselves indefinitely under favorable conditions.

No *Bacilli* or other bacterial filaments could be found either in the pus, in the peritoneal effusion, or in the blood; nor did any develop in these liquids while preserved from contact with the air.

While at Charlotte, July 2, 1880, Mr. Wadsworth informed me that hogs were dying of cholera on his farm near the city, and kindly gave me permission to kill any animals that I might wish to examine. I found about fifty hogs running in a large wood lot through which flowed a small stream of water. A walk through the lot disclosed three dead animals already in an advanced stage of decomposition. A number of others were plainly sick, some of which had abscesses one-half inch to three inches in diameter scattered over the surface of the body. The one showing most marked symptoms was selected and slaughtered. This animal had a large abscess in the flank fully six inches in diameter with very thick fibrous walls. Similar though smaller ones existed beneath the thorax. The abdomen was distended with a colorless, transparent peritoneal effusion, the intestines adhered closely from the formation of false membranes, and in the duodenum were many small erosions. The spleen was enlarged and the lymphatic glands engorged with blood. The pericardium contained one-half ounce of clear liquid; the lungs were mottled with lobular pneumonia, but there was no pleural effusion. In the intestine were found in large number the parasitic worms known as *Echinorynchus gigas* and *Sclerostoma dentatum;* the *Stephanurus dentatus* abounded in the fat about the kidneys, and the *Strongylus elongatus* existed in considerable numbers in the bronchi.

Two vacuum tubes were filled with blood by forcing the finely-drawn-out end, previously passed through the flame of an alcohol lamp, into a small vein, then breaking across the walls of the vessel and allowing them to fill. They were then immediately withdrawn and sealed. Two other tubes were filled with peritoneal effusion by plunging deeply beneath the surface, to avoid germs from the atmosphere, before breaking the points. One tube containing blood and one with peritoneal effusion were sent to Professor Law, with a request that he make a careful microscopical examination of their contents as soon as they were opened. The remaining two were kept for my own examination.

Just here it seems advisable to call attention to the capillary vacuum tubes made and used by me for these investigations. A piece of glass tubing, with an internal diameter of about one-eighth of an inch and two inches in length, is drawn out to a fine tube about one-twentieth of an inch in diameter at each extremity. After cooling, a few drops of water are forced into the body of the tube, and boiled in the flame of the lamp till entirely vaporized; the tube is not yet withdrawn, however, but is held in the flame till nearly red, when the two extremities are quickly sealed. Made in this way, the tube when sealed contains superheated steam, and the temperature is so high that no germs can possibly withstand it: on cooling, the steam condenses and forms a scarcely visible globule of pure distilled water, leaving the cavity almost a perfect vacuum. If, now, we pass such a tube through the flame of an alcohol lamp to destroy any germs adhering to its surface, then force one of the ends through the wall of a freshly-laid-bare vein, break the extremity within the vein by pressure across its walls, allowing the tube to fill with blood never for an instant exposed to the air, and then immediately seal the broken end in the flame of a lamp, we may keep such a tube for an indefinite time for the germs contained in the blood to multiply and develop, and still feel reasonably certain that what we see, when examining its contents, was in the blood while circulating in the veins. But if we allow the blood to come into contact with the air for a single second, loaded as the atmosphere is with the germs of every variety of bacteria, there is no longer any safety in concluding that the *Bacilli* and other septic organisms, which develop after a few hours or days, really existed in the blood during the life of the animal. Consequently we cannot lay great stress upon the organisms found in the tubes containing the effusion, because this necessarily comes in contact with the air when the cavity containing it is opened, but it was believed that most of the atmospheric germs would float on the surface, and that by plunging the extremity of the tube to be broken well into the liquid most of these would be avoided.

With this in advance as to the method employed, I will now give the results of the examination of the contents of the tubes July 12, or ten days after filling.

The clot formed in the tube containing blood was partly dissolved, and, on breaking, a small quantity of gas escaped. The liquid swarmed with micrococci, some existing as single spherical granules (monococci), others united by twos or threes, many in long chains (streptococci), while still others were in *zooglœa* masses (gliacocci). In whatever form they existed they were of uniform size and spherical, and had the Brownian movement in a very marked degree. Fig. 6 shows a part of a field in one of these preparations. There were no *Bacilli* whatever to be found, nor indeed could any other organism be discovered with the exception of a single oval fungus spore $\frac{1}{12000}$ by $\frac{1}{8000}$th of an inch in size, which possibly gained entrance after the blood was placed on the slide and before it could be covered with the thin glass.

The tube that contained the peritoneal effusion showed from its appearance that decomposition had advanced to a considerable extent; on breaking there was a marked escape of gas with a very offensive odor. The same micrococcus forms as were found in the blood existed in vast number, and in addition there were *Bacterium termo*, some members of a broad *Bacillus* $\frac{1}{20000}$th of an inch in diameter, containing oval spores, and also a fine *Bacillus* $\frac{1}{35000}$th of an inch in diameter.

Professor Law wrote me that he examined the tubes sent to him on the 8th of July, or four days earlier than I was able to examine mine. For this he used a Hartnack No. 10 immersion objective, which is of about the same power as the lens used by me. In the blood he found no *Bacilli*, and no active organisms of any kind; besides the blood globules there were a very few crystals and isolated granules.

In the peritoneal effusion, on slides not passed through the flame of a lamp, he found very many *Bacillus* forms, but on flamed slides there was an organism somewhat like *Bacterium termo* and minute granules, with a single non-motile filament. With this virus he succeeded in producing a case of swine plague with characteristic intestinal lesions.

I inoculated two pigs from each of the tubes which I retained, as soon as they were opened and their contents examined. Those inoculated with the peritoneal effusion showed no signs of ill health, but those inoculated with the blood both sickened. July 19, or seven days after inoculation, they had diminished appetite, a dull appearance, with a temperature of 103° and 104$\frac{3}{4}$° F., respectively. July 21, no appetite, dull, slightly staggering gait; temperature 103$\frac{1}{2}$° and 105° F. The next day they had diarrhea, which was followed in a few days by constipation.

August 6 there was signs of improvement, when one of the animals was killed. The whole intestinal tract was found reddened, and the mucous surface of the large intestines was studded with small ulcerations, the cæcum being most involved. The liver was mottled, and the lungs extensively hepatized. The blood, before and after death, contained the spherical granules; in the latter case a few chains and zoogl&oelig;a masses were observed. In the blood drawn from the ear and in blood caught in a bottle at the time of slaughter, a number of oval granules $\frac{1}{30000}$th of an inch in short diameter or smaller were observed—they resembled *Bacillus* spores, but as no precautions to prevent access of air had been taken they probably gained entrance after the blood was drawn; indeed, I have frequently seen such granules in blood from my own finger placed on a slide and immediately examined.

What I wish to insist upon, by way of conclusions from this series of observations, is as follows:

1st. The pig killed at Charlotte July 2, 1880, was affected with swine plague, as is proved not only by its lesions but by inoculations made by Professor Law and myself.

2d. The blood of this animal had not developed *Bacilli*, even when preserved for six and ten days after the slaughter.

3d. The microscope with a power of one thousand diameters revealed in the blood thus preserved vast numbers of *spherical* granules, not all isolated, as is seen in the case of spore formation by the disintegration of *Bacillus* rods, but united in chains and clusters of every conceivable form, as occurs with micrococci in active multiplication; and in this blood could be discovered neither *Bacillus* rods nor oval or cylindrical spores of these.

4th. This blood was still virulent, as was shown by inoculation on two animals, both of which sickened in seven days, with the characteristic symptoms of swine plague, and one of which, when slaughtered, presented typical lesions of this disease.

CULTIVATION OF THE VIRUS.

1. *Cultivation on slides.*—March 10, five slides were prepared by putting a drop of fresh aqueous humor of a rabbit on the thin cover; this was then inoculated with the smallest possible particle of coagulum taken from a capillary tube filled at Pickens, S. C., December 29, 1879, with effused liquid found in the peritoneal cavity of a pig suffering from swine plague. The cover thus prepared was then inverted over a Brunswick black cell painted on an ordinary glass slide. As a moist chamber, in which to keep these free from evaporation, an ordinary soup-plate was half filled with sand previously dried at a high temperature and now moistened; across this wet sand glass tubes were laid to keep the slides from coming in contact with it, and the slides placed thereon, when the whole was covered with a square of glass to retain the moisture. The whole was kept in an incubator at 95° to 100° F.

Five hours later the drops of aqueous humor were swarming with single granules and aggregations of these—nearly all with molecular motion.

Twenty-four hours after inoculation the preparations were filled with the aggregations of granules; no movement in any, and but few single granules to be seen. No *Bacilli.*

A slide prepared in the same way but inoculated from another tube was examined immediately after inoculation and the inoculating particle found to be filled with the mycelium and spores of a fungus. As other preparations were entirely free from such organisms the presence of this was not considered as having any connection with the subject under investigation. The granules were also present in vast numbers singly and in clusters.

March 18. No *Bacilli* have developed in any of these preparations; they have been examined carefully every day. In only one of them is there any activity; this swarms with single granules and small aggregations as in a freshly-inoculated cell. Most of the clusters are of considerable size, held together by a gelatinous matrix. A very few short rods $\frac{1}{12000}$th of an inch in length have been found. Nearly the whole space to be seen is occupied by the granules.

Final examination, March 25. No material change since the last examination. All activity has ceased; the granules have not developed into filaments.

March 12, four slides were prepared, using urine as a cultivating medium, and inverting the thin cover directly on the slide to favor the access of air. In other respects the cultivation did not differ from the preceding one.

March 13 and 14, the micrococci alone are seen in various-sized clusters as before.

March 15, filaments have grown from a few of the clusters (Fig. 8), but whether the granules of such clusters were identical with the others could not be ascertained; certainly the vast majority of clusters showed no sign of producing filaments. A considerable number of fungus cells exist in some of the preparations, and mycelium from these has grown luxuriantly. In these preparations the granules were first observed in the form of a chain, made up at times of thirty or more elements.

March 23, all of the slides are crowded with the micrococci; on three of the slides are to be seen a considerable number of fine rods $\frac{1}{50000}$th of an inch or less in diameter, and $\frac{1}{2000}$th of an inch in length. In two a few fungus spores and mycelium.

2. *Cultivation in test-tubes.*—March 9, six test-tubes were partly filled with infusion of beef and sterilized by heat. They were closed by rubber corks, through which passed a glass tube packed with cotton wool for ventilation. They were inoculated with one drop each from a capillary tube containing virus. March 16, but two of the tubes were found to contain a pure growth of the granules, the others contained considerable numbers of a *Bacillus*, resembling *Bacillus subtilis*, another with a much finer filament, and also *Bacterium termo.*

Six tubes of the same infusion were placed in the incubator at the same time to determine what organisms would develop spontaneously. In all of these could be found the broad and the fine rods already mentioned, and in two were observed clusters of granules with exactly the same appearance as those which developed from the virus. Inoculations made from these were followed with a slight eruption and reddening of the skin, but without other signs of sickness.

Effect of disinfectants on this micrococcus.—So constantly were the granules which I have just described and figured found in the blood and liquid inflammatory products of the sick pigs which I had the opportunity to examine, that it was deemed advisable to test its powers of resistance to various agents supposed to have disinfecting properties. It was hoped that by comparing the effects of such agents upon this organism, as shown by direct microscopical observation, with the effect of the same agents on the activity of the virus, as proved by inoculation, a safer conclusion could be reached as to whether this organism really constituted the active principle of the virus. For some unknown reason it has been impossible for me to obtain a form of swine-plague sufficiently virulent to allow me to carry out the second part of this programme. I have several times succeeded in producing by inoculation very severe cases, though no fatal ones; but when a second inoculation was made with blood or inflammatory effusions of such sick animals, even when two or three cubic centimeters were injected hypodermically, the disease produced would be so mild as to be scarcely noticeable. Conclusions from such experiments are evidently so unsafe that I finally relinquished the idea of accomplishing anything in this direction until more favorable conditions should prevail.

The experiments were made with the micrococcus by adding a drop or two of the liquid in which it existed to a test-tube half filled with fresh urine, which seems to be a very favorable medium for its development; a measured quantity of the disinfectant was then added and the tube covered with sheet caoutchouc closely tied on. The tubes were kept in an incubator at a temperature of 90° to 100° F. for a few days, when a microscopical examination determined if there had been any multiplication of the organism in question. It was thus determined that it would multiply in a solution containing 1 per cent. of carbolic acid, but not in one containing 2 per cent.; and that a 2 per cent. solution even destroyed the life of the granules. To prevent its multiplication required 2 per cent. of borax, 1 per cent. of benzoic acid, one-third per cent. of either sulphate of quinine or iodine, one-fifth per cent. of salicylic acid, and one-tenth per cent. of chloride of zinc. Quassia, even in a 4 per cent. solution of the extract, had no effect upon it. It was destroyed by a heat of 150° F. for fifteen minutes, but resisted 140° for the same length of time.

Of course the fact that an organism will not develop in a 1 per cent. solution of carbolic acid is no proof that it is destroyed by a solution of this strength; the solution may be simply unsuitable for the development of the germs, these remaining in a dormant condition. The destructive effect of a disinfectant may be learned by slightly varying the experiment; thus, we place two drops of the virus in a watch-glass and add to it two drops of a 2 per cent. solution of the disinfectant, making the mixture equal to a 1 per cent. solution. After mixing and leaving in contact for an hour or two the whole may be added to a test-tube containing a solution favorable for the development of the organism. Its multiplication is then the criterion by which to judge of the effect of the disinfectant. In all such cases the greatest care must be exercised to prevent the addition of atmospheric germs. The tubes, &c., must be boiled for several hours or heated nearly to redness before using. Even then, it is generally impossible, without more complicated apparatus, to prevent the introduction of the septic bacteria; but the germs used for inoculation are in so much the greater number that as a rule they obtain the advantage in the struggle for existence.

It occurred to me that there might be septic organisms having the same appearance as the one I was cultivating, and that the introduction of such might vitiate the experiments. To decide this point a large number of tubes containing nutritive solutions exposed for several days to the contact of the air were examined to determine the forms then present in the atmosphere. In two instances an organism similar to the one I was cultivating thus appeared spontaneously, and, when inocu- d, in one case produced a slight eruption, as already reported.

There were three or four kinds of *Bacilli* that were present in nearly every putrefying liquid. One of these was less than the $\frac{1}{35000}$th of an inch in diameter, another was about $\frac{1}{30000}$th of an inch, and the largest about $\frac{1}{20000}$th. These, with *Helobacteria* and the *Bacterium termo*, were the forms most commonly met with.

A more extended consideration of the theory of the swine-plague contagium will be found in Part III of this report.

PART II.—INVESTIGATIONS OF FOWL CHOLERA.

It has long been evident that an exceedingly fatal contagious disease of fowls has become distributed over the whole country, and that it causes enormous annual losses. This disease is popularly known as chicken cholera.

A similar if not identical malady causes extensive losses among the poultry of Europe; in France this is also called cholera (*choléra des poules*). Some investigations of its nature were made some years ago by M. Reynal, and quite recently it has been more carefully studied by MM. Toussaint and Pasteur.

As long ago as December, 1879, I commenced investigating the epizootic diseases from which fowls were dying. At first I was unfortunate in fixing my attention on enzootics evidently due to local causes. Of three separate outbreaks thus investigated not one proved to be the result of inoculable disease; and it was not until July, 1880, that I succeeded in obtaining virus of what is undoubtedly the true chicken cholera, by which so many fowls are swept away. This disease existed at the house Mr. R. M. Miller, of Charlotte, who informed me that he had lost on his farm nearly 500 chickens from it during the year. At the time of my visit, his Plymouth Rocks, which he kept at his house in the city, were suffering. I at once inoculated two spring chickens with excrement from living sick birds and with blood, bile, and pieces of liver from those recently dead. After five days they were still perfectly well. The French investigators having determined that death occurs within two or three days after inoculation, and most frequently within twenty-four hours, I had nearly concluded that our chicken cholera was not an inoculable disease; but in order to be absolutely certain I requested Mr. Miller to allow me to bring a hen in the first stages of the disease to my own farm, more than one hundred miles away, and on which no contagious disease of fowls had ever existed. This he kindly consented to, and it was with virus obtained from this bird that my experiments were made.

The disease proved to be inoculable, and the period of incubation so much longer than with the affection as it exists in France as to explain why the chickens inoculated at Charlotte did not sicken. I have not learned if they contracted the malady later, as I was unable to bring them with me; but this matters little, as I have now the most complete evidence of the transmissibility of the disease.

For convenience of examination and to avoid repetitions, the inoculation experiments will be related first, then the symptoms and *post-mortem* appearances, and, finally, my microscopic investigations.

EXPERIMENTAL STUDY OF THE DISEASE.—1. IS IT COMMUNICABLE?

Experiment No. 1, *July* 10.—The Charlotte hen was placed in an inclosure rather less than 6 feet square, with three other hens, and, to make infection more certain, a large double-sheet newspaper that he been in the bottom of the basket used for transporting the hen, and which was saturated with the excretions, was thrown into the inclosure.

July 13.—The Charlotte hen found dead this morning. Two of the hens inoculated by placing under the skin and into the muscular masses beneath the wing by means of a grooved lancet, bowel contents, blood, liquid pressed from liver, and even small particles of this organ, three or four punctures being made in each case. The liver and parts of muscle were then cut into small pieces and fed to these hens. It was believed that this would decide the question of communicability.

July 17.—One of the inoculated hens appears less lively than usual, and the comb is losing its bright healthy hue.

July 18.—This hen has diarrhea, and is plainly sick.

July 19.—She sits sleeping, and is only startled with difficulty. Temperature at 7 a. m., 104° F. Died at 7.40 a. m., or six days after inoculation. The second hen has diarrhea, and a temperature of 108¾° F. The third hen not inoculated but kept in the same inclosure is apparently well. Temperature 107° F.

July 22.—The second hen inoculated is very sick; does not notice what is occurring about her; sleeps continually, and is only roused by a touch. She is very weak, and has great difficulty in walking. Temperature 108½° F.

July 23.—This hen is dead, ten days after inoculation. The remaining hen still well.

The disease is, then, certainly communicable; but in what way has this infection occurred? Several different substances have been used for inoculation; the birds affected were even fed portions of the liver and muscles of a dead hen; they cohabited with her. Evidently the next point to be determined was as to whether the malady had been contracted from the inoculations, through the food, or by inspiring infected air. It is true the hen not inoculated remained well, but the period of incubation may be longer with her, or she may be insusceptible. Before commencing a series of investigations, it is necessary to know what parts of the body or which of its liquids contain the virus and are to be depended upon as a means of inoculation.

2.—THE LIQUIDS OR ORGANS CONTAINING THE VIRUS.

Experiment No. 2, *July* 19.—A hen inoculated by two lancet punctures with fluid pressed from liver.

July 23.—Diarrhea and dullness.

July 24.—Very sick; temperature at 7 a. m., 109½°. Dies at 3 p. m.

Experiment No. 3, *July* 23.—One hen inoculated by two punctures with excrement from the cloaca of a hen just dead.

This bird was kept under observation for six weeks but no effect followed the inoculation. She was probably insusceptible.

Experiment No. 4, *July* 23.—One hen inoculated by two lancet punctures with blood from the heart of a hen just dead.

July 29.—Diarrhea.

August 7.—Very sick.

August 8.—Died during the night.

In all the inoculations noticed in this report the lancet was disinfected by heating to redness, and every precaution taken to prevent mistaken conclusions.

Experiments Nos. 2 and 4 prove, then, that the liquid pressed from the liver and the blood contain the virus. Experiment No. 3 resulted negatively; it does not prove that the excrement is free from the virus, for the hen may have been insusceptible to the disease. At the time of writing I have not been able to repeat the experiment.

3.—EFFECT OF TAKING THE VIRUS WITH THE FOOD.

Experiment No. 5, *July* 23.—The hen placed with the sick one from Charlotte July 10, but not inoculated, has remained well, though four birds have now died in the same inclosure. A large Plymouth Rock cock is placed with her, and the two fed with the liver and muscles from the breast of a hen that died the preceding night. A third hen inoculated with liquid from the liver for comparison.

July 27.—Both have diarrhea; temperature of hen 109°, of cock 107° F.; temperature of hen for comparison 107¼° F.

July 28.—Hen has a temperature of 109¼° F.; comb and gills pale, cold, and bloodless. Cock has a temperature of 108½° F. The hen inoculated for comparison has also pale comb and gills; temperature 107½° F.

July 31—Hen dead.

August 2.—Cock found dead this morning.

The hen inoculated for comparison has little appearance of the disease. She was again inoculated to test her susceptibility; sickened August 7; began to improve August 13, and was well by the 20th.

Considering that the hen had been in this inclosure for thirteen days without contracting the disease, and that both she and the cock sickened in four days, I think we have here sufficient proof that the disease was contracted through the food. This is also the conclusion of the French investigators, and is confirmed by other facts in regard to the contagion.

4.—ARE THE GERMS TRANSPORTED BY THE ATMOSPHERE?

Experiment No. 6, *July* 29.—Two hens were placed in a coop within 4 feet of the one in which most of the deaths already reported had occurred, and in which sick fowls have been continually kept to prevent loss of virus. The coop in which the two hens were placed was occasionally moved its width to keep on fresh ground, but was never farther than 10 feet from the one in which were the sick ones. It remained thus till October 6, or sixty-nine days, both hens being still in the best of health.

In my other experiments I have had as many as fifty fowls within a few yards of sick ones, some having remained this near for one or two months, and in only one case has the disease appeared except from my inoculations.

Major Cox, of Atlanta, informed me that he had not been able to raise fowls at his place in that city for years on account of the cholera. But his neighbor, whose lot is only separated from his own by a stone-wall, was never troubled with the disease till the past year.

Here, then, appears to be good evidence that the germs of the disease are not transported through the atmosphere. In one case, however, a chicken in one of my experimental coops did take the disease spontaneously and die with it; but, more remarkable than this, two hens and one half-grown chicken of my home flock, kept at a distance of more than 200 yards from the coops of the sick ones, have contracted the disease and died. And the periods between their sickness were so long as to make it certain they did not contract the trouble from each other. One of these was just weaning a brood of chickens, and as she sickened no longer drove them from her; as a consequence they crowded about her, perched upon her back, and even sheltered themselves beneath her wings. Only one of these chickens ever sickened, and that so long (five weeks) afterwards as to make it certain the disease was not contracted from the mother.

I have concluded, therefore, that the disease is not contracted from germs carried through the atmosphere, in the strict sense of the term, but that we owe such occasional transportation of the disease to flies or other insects which eat the blood during dissection, or which feed upon the other juices of the body, or upon the excretions. A fly, for instance, will eat sufficient blood to inoculate twenty or thirty fowls, and if captured soon after such a meal by a susceptible bird would almost certainly convey the disease, since the germs taken with the food have the same effect as when inserted under the skin with a lancet.

5.—IS THE DISEASE CONTRACTED FROM INFECTED HABITATIONS?

Experiment No. 7, *October* 6.—A Plymouth Rock cokerel placed in a coop in which there have been sick fowls almost continually since July 10, the last one affected having died September 27, or nine days earlier.

October 20.—Plainly sick.

October 21.—Dead.

This, then, is a positive experiment; the bird contracted the disease after being fourteen days in the infected coop and died on the fifteenth day.

6.—EFFECT OF PUTREFACTION ON VIRUS.

Experiment No. 8, *July* 30.—One hen inoculated with fluid pressed from the liver, July 24, and which has a strong odor of putrefaction. This hen has remained well to the present, and has been proved insusceptible by two subsequent inoculations. The experiment is, therefore, without result.

7.—EFFECT OF DRYING THE VIRUS.

Experiment No. 9, *July* 30.—A cock affected with cancer of the comb inoculated with pieces of dried liver, prepared by cutting a thin slice and drying at ordinary atmospheric temperature for seven days. No effect resulting, he was reinoculated with active virus September 4 to test his susceptibility, but he died September 8 from the effect of the cancer before any signs of cholera had appeared.

8.—EFFECT OF DILUTING VIRUS.

Experiment No. 10, *July* 31.—One hen inoculated with a mixture made by diluting one drop of fluid pressed from the liver with twenty-five drops of diluted glycerine (glycerine one part, distilled water eight parts), having about the specific gravity of blood. Two punctures were made into the muscular masses beneath the wing with the grooved lancet charged with this virus.

August 20.—Has drooped for several days, voids large quantities of excrements of a normal consistency, the urates of which are deeply colored with yellow.

August 24.—Has diarrhea; very sick.

August 27.—Much better.

August 29.—Entirely recovered.

Experiment No. 11, *July* 31.—One hen inoculated by two lancet punctures with virus diluted as above with one hundred parts of glycerine mixture. No effect. Has since been inoculated and proved insusceptible.

It would appear from these experiments that diluting the virus prolongs the period of incubation and produces a disease of a milder form. The hen in experiment No. 11 may have had so mild a form of the disease that it was not noticed, and may thus have acquired her insusceptibility. It would be unsafe to reach any conclusion, however, without more experiments.

9.—THE BLOOD IN THE BODY RETAINS ITS VIRULENCE THIRTY-SIX HOURS AFTER THE DEATH OF THE BIRD.

Experiment No. 12, *August* 9.—Two chickens inoculated with liquid pressed from liver of a hen found dead yesterday morning (thirty-six hours ago) and which was not examined until to-day.

August 20.—One has diarrhea, sleeps, temperature 109° F.

August 23.—Both now very sick.

August 25.—One dead.

September 10.—The second dead.

10.—THE ALCOHOLIC EXTRACT OF BLOOD NOT VIRULENT.

Experiment No. 13, *August* 11.—Two spring chickens inoculated with alcoholic extract prepared by treating blood and fluid, pressed from liver with an equal volume of 95 per cent., alcohol, allowing it to stand thirty-six hours, and then filtering and drying the residue. No effect produced. The birds afterwards proved susceptible when inoculated with active virus.

11.—EFFECT OF SALICYLIC ACID ON VIRUS.

Experiment No. 14, *August* 25.—Virus prepared by intimately mixing with an equal volume of a 2 per cent. solution of salicylic acid containing sufficient borax to cause the acid to dissolve. The mixture, which consequently equaled a 1 per cent. solution, then allowed to stand three hours, when two chickens were inoculated by means of four lancet punctures each, two under each wing. No effect produced. The activity of the virus and susceptibility of the birds both proved by other inoculations.

12.—EFFECT OF BENZOIC ACID ON VIRUS.

Experiment No. 15, *August* 25.—Virus prepared by mixing with an equal volume of a 2 per cent. solution of benzoic acid, containing sufficient borax to cause the acid to dissolve. The mixture thus equal to a 1 per cent. solution of the acid, allowed to stand two and one-half hours, and inoculated by two lancet punctures under each wing of two chickens. No effect. The virus, before treatment with the acid, was proved active by inoculation.

Experiment No. 16, *September* 17.—Four chickens, inoculated by hypodermic injection, of one cubic centimeter each of virus, containing 1 per cent. of benzoic acid and 1½ per cent. of borax, and allowed to stand four hours after preparation before using.

September 26.—These chickens received a second hypodermic injection of two cubic centimeters each of virus, treated with same proportion of benzoic acid and borax as above. Have remained in good health.

healthy till September 30, when they were inoculated with active virus. One died and the other proved insusceptible.

Experiment No. 28, *September* 1.—One hen and one chicken inoculated by four lancet punctures, with blood that had been heated to 160° F. for fifteen minutes, have remained in perfect health, and prove insusceptible to subsequent inoculations with active virus.

Experiment No. 29, *September* 1.—Two chickens inoculated by four lancet punctures, with virulent blood that had been heated to 150° F. for fifteen minutes, remained in perfect health till September 17, when they were inoculated with active virus to test susceptibility. Both contracted the disease and died—one September 26, the other two days later.

Experiment No. 30, *September* 1.—Two chickens inoculated by four lancet punctures each, with blood that had been heated to 140° F. for fifteen minutes. Both remained in good health till September 17, when they were inoculated with active virus. One died September 26, the other proved insusceptible.

Experiment No. 31, *September* 1.—Two chickens inoculated with virulent blood that had been heated to 132° F. for fifteen minutes, four punctures each, remained in good health till September 17, when they were inoculated with active virus. One died September 27, the other had the disease in a mild form and recovered.

Experiment No. 32, *September* 6.—Two chickens, inoculated by hypodermic injection, of one cubic centimeter each of virus, that had been heated to 140° to 148° F. for two hours. No result.

Experiment No. 33, *September* 26.—Four chickens inoculated with virulent blood that had been heated to 145° F. for one hour. Hypodermic injection of one cubic centimeter each.

September 30.—They receive a second injection of 1½ cubic centimeters each of virulent blood that had been heated to 145° F. for two hours. All remained in good health.

Experiment No. 34, *September* 17.—Four chickens each receive a hypodermic injection of one cubic centimeter of virus that had been heated to 135° to 138° F. for one-half hour.

September 23.—Two chickens dull, little appetite, some diarrhea. No other symptoms noticed and September 30 all were in perfect health.

Experiment No. 35, *October* 25.—Three chickens inoculated, by four lancet punctures each, with virulent blood that had been heated to 130° F. for fifteen minutes.

November 1.—Yellow urates.

November 2.—Plainly sick.

November 6.—One dead.

November 8.—Remaining two dead.

Experiment No. 36, *October* 25.—Two chickens inoculated by four lancet punctures each, with virus that had been heated to 128° F. for fifteen minutes. Neither contracted the disease.

Experiment No. 37, *October* 25.—Two chickens inoculated by four lancet punctures each, with virulent blood that had been heated to 126° F. for fifteen minutes.

October 27.—Yellow urates.

November 2.—One dead.

The other did not contract the disease.

Experiment No. 38, *October* 25.—Three chickens inoculated by four lancet punctures each, with virulent blood that had been heated to 124° F. for fifteen minutes.

October 27.—Yellow urates.
November 5.—Plainly sick.
November 7.—Two dead.
The third insusceptible.

21.—ONE ATTACK OF THE DISEASE PROTECTS AGAINST THE EFFECT OF SUBSEQUENT INOCULATIONS.

Experiment No. 39.—Three fowls used: one was the hen pronounced entirely recovered August 29 (experiment No. 11); the second was a hen that had entirely recovered August 20; the third was a cockerel that had a mild attack and recovered about September 25. The two hens had a very severe attack.

October 14.—Inoculated by four lancet punctures each, with virulent blood. All remain in perfect health.

22.—A CERTAIN NUMBER OF FOWLS RESIST INOCULATION.

Since beginning my experiments with this disease, I have inoculated in all about ninety-five fowls (up to November 1). Of these, two had the disease severely and recovered; three have had it mildly and recovered; and twenty-five others now resist both inoculation and exposure in an infected coop. Whether any of the twenty-five have had the disease in a form so mild as to escape observation, or whether they all have had from the first a natural insusceptibility, it is, of course, impossible to say. Fowls are frequently quite sick when the first symptoms are noticed. The yellow coloration of the urates in the excrement has, in all cases, been the earliest symptom observed; at this time the temperature may be one or two degrees higher than normal, or it may not be appreciably affected. But I find this coloration is not an infallible sign of the malady; in some cases a slight yellow tinge or even a distinct coloration may occur when no exposure has taken place; while often it occurs within a day or two of inoculation and before the disease has had time to develop, disappearing again till the incubation is finished. Hence, this is a somewhat uncertain criterion as to the mild cases.

Again, drooping, sleepiness, and loss of appetite frequently do not occur until the disease is considerably advanced.

With these explanations, the following statement is made as the result of my observations on this point: Of the ninety-five fowls inoculated the result is not yet (November 1) known in regard to fifteen. Of the eighty remaining, six have recovered, twenty-five have not been visibly affected, and forty-nine have died. From these experiments, then, we might conclude that if one hundred fowls were inoculated with the ordinary virus, sixty-nine would take the disease, and of these sixty-two would die and seven recover; while thirty-one would not be visibly affected. This result may be more or less misleading, however, since, in one lot of twenty, fourteen proved insusceptible, two were slightly affected and recovered, and only four died; it is evident, therefore, they had, before coming into my hands, been subjected to conditions which enabled them to resist the effects of the virus in a most remarkable manner. Leaving this lot out of consideration, and of sixty fowls inoculated forty-five have died, four have been affected and recovered, and eleven only have proved insusceptible. From this we might conclude that by inoculating one hundred ordinary fowls, we would have seventy-five deaths, seven recoveries, and eighteen that would prove insusceptible.

23.—DEVITALIZED VIRUS AS A PREVENTIVE.

One of the most important advances in our knowledge of the phenomena of contagia, is the discovery of Toussaint,* made during the present year, that inoculation of susceptible animals with anthrax blood previously heated to 55° C. (131° F.) for ten minutes, enabled such animals to resist subsequent inoculations with active virus. Of course, such an important fact at once led to theories as to how such an effect could be produced, and suggested that the discovery might be extended to other contagious fevers. Chauveau, who† had just discovered that the inoculation of Algerian sheep with anthrax virus during the latter part of the period of gestation, conferred immunity on the lambs subsequently produced, supposed this was due to some substance formed in the body by the multiplication of the parasite rather than to something being subtracted from it by the same means.

The discovery of Davaine that the *Bacillus anthracis* did not penetrate into the blood or tissues of the fœtus, though swarming in the blood of the mother, seemed to indicate that the immunity conferred upon the lambs was due to a soluble substance capable of passing by osmosis from the blood of the mother into that of the fœtus.

Pasteur‡ believed that the non-recurrence of contagious fevers was rather due to something taken from the tissues by a first attack. Toussaint § believed at this time that he entirely destroyed the parasite by the heat, and even recommended that one-half per cent. of carbolic acid be added to the blood, after being raised to the required temperature, and this allowed to stand two or three days, to make the destruction certain. This view seemed the more reasonable, as Davaine || had found several years before that the virus of anthrax was entirely destroyed by being kept at 55° C. for only five minutes, and that it was destroyed in ten minutes at 50° C. I at once determined to test the effects of inoculation with virus devitalized by heat as a preventive of fowl cholera, and for this purpose the following experiments were made:

Experiment No. 40, *September* 3.—It being difficult to obtain sufficient blood, an enlarged liver from a bird found dead this morning was triturated with one ounce of distilled water, and to this was added what blood could be gathered from the body. The whole, strained through a linen cloth, produced a muddy, brownish liquid, which was boiled over a water-bath for ten minutes, and resulted in a clear straw-colored liquid and a brown coagulum. A second straining produced a slightly turbid fluid, which was heated to 180° F., at 9 p. m., to prevent putrefaction.

September 4.—Four chickens received a hypodermic injection of one cubic centimeter each of the fluid described above.

September 6.—A second injection of one cubic centimeter each of same liquid, which had twice been heated to 180° to preserve it.

September 17.—Inoculated by four lancet punctures each with active virus.

September 23.—One or more sick.

September 24.—One dead.

September 27.—Another sick.

September 28.—One nearly dead was killed for examination. The two remaining proved insusceptible.

---

* Comptes Rendus, xci (1880), p. 303; Bul. de l'Acad. de Médecine, 1880, p. 753.

† Comptes Rendus, xci (1880), p. 151.

‡ Bul. de l'Acad. de Médecine, 1880, p. 131.

§ The Veterinary Journal, 1880, vol. xi, p. 152.

|| *Quoted by Bouley* in Recueil de Med. Vet., 1874, p. 563.

Experiment No. 41, *September* 1.—Eight chickens inoculated with four lancet punctures each. Two with virus that had been heated to 160° F.; two with that heated to 150°; two with that heated to 140°; and two with that heated to 132°; in each case the heat was applied for fifteen minutes.

September 17.—The eight inoculated by four lancet punctures each with active virus.

September 26.—Two die.

September 27.—One dies, and one that has been sick has recovered.

September 28.—One dies. Three prove to be insusceptible.

Experiment No. 42, *September* 6.—Two chickens receive a hypodermic injection of one cubic centimeter of virus that had been heated to 140° to 148° F. for two hours. One of these unfortunately disappeared from its coop before the experiment was concluded.

September 17.—The one remaining inoculated by four punctures with fresh virus.

September 19.—Urates deeply tinted with yellow, though excrement is still solid.

September 23.—Yellow coloration has disappeared, appetite and appearance good. From this time it remained well.

Experiment No. 43, *September* 17.—Four chickens receive a hypodermic injection of one cubic centimeter each of virus that had been heated to 135° to 138° F. for one-half hour.

September 23.—Two seemed dull, with little appetite and some diarrhea; by September 30 they were all in perfect health.

October 14.—Inoculated by four lancet punctures each with active virus.

October 22.—Yellow urates noticed.

October 24.—One dead.

November 1.—The remaining three well.

In view of the fact that 132° has been sufficient to entirely destroy the activity of the virus, it may be doubted if the two that were ailing, after the hypodermic injection, really had a mild form of cholera. This lot belonged to the twenty that were found so insusceptible, and of which one lot of four kept for comparison have been three times inoculated with active virus without showing any signs of disease.

Experiment No. 44, *September* 26.—Four chickens receive a hypodermic injection of one cubic centimeter of virus that had been heated to 145° F. for an hour.

September 30.—Have a second injection of one and one-half cubic centimeters of blood that had been heated two hours to 145° F.

October 6.—One killed by its fellows.

October 14.—Inoculated the three remaining by four lancet punctures each with active virus.

October 20.—Two sick.

October 22.—One dead.

October 23.—One dead.

The third had a mild attack, with yellow urates and loss of appetite for two or three days, and recovered.

Experiment No. 45.—Four chickens receive a hypodermic injection of one cubic centimeter of virus made into a one-half per cent. solution of sulphuric acid and allowed to stand four hours before using.

September 22.—Two have yellow urates and droop, with little appetite.

September 30.—All are well.

The sickness believed to be due to the irritating effects of the sulphuric acid.

October 14.—Inoculated with active virus.

October 25.—One dies; one killed by a wild animal.

October 28.—Yellow urates still noticed.

November 1.—The two remaining are well.

This lot was also part of the twenty insusceptible birds, of which four inoculated for comparison all remained well.

Experiment No. 46, *September* 17.—Four chickens have each a hypodermic injection of one cubic centimeter of virus to which had been added four hours before one per cent. of benzoic acid and one and one-half per cent. of borax.

September 26.—Receive a second injection of two cubic centimeters each of virus prepared as before.

October 14.—Inoculated by four lancet punctures each with fresh virus.

All remained in the best of health.

This lot again was part of the twenty insusceptible birds, and consequently the experiment has only a negative signification.

Experiment No. 47, *September* 17.—Four chickens receive a hypodermic injection of one cubic centimeter each of virus to which 1 per cent. of carbolic acid had been added five and one-half hours before using.

September 26.—Have an injection of one cubic centimeter each of virus prepared as before.

October 14.—Inoculated by four lancet punctures each with active virus.

October 22.—Yellow urates noticed.

October 28.—One dead.

November 2.—Yellow urates still observed.

November 5.—All are well.

These were also a part of the insusceptible lot.

This series of experiments is one of the most difficult from which to draw conclusions of any I have made; and to assist in this I have prepared the following table showing results:

Number of experiment.	Total birds.	Die.	Recover.	Insusceptible.	Die from other causes.
40	4	2	......	2	......
41	8	4	1	3	......
42	2	......	1	......	1
43	4	1	......	3	......
44	4	2	1	......	1
45	4	1	1	1	1
46	4	......	......	4	......
47	4	1	1	2	......
8	34	11	5	15	3
Deduct experiment Nos. 43, 45, 46, and 47, the birds of which were insusceptible	16	3	2	10	1
Results with susceptible birds	18	8	3	5	2

Almost any one who had not followed these experiments from day to day would be likely to arrive at conclusions from them which I am satisfied are not in accordance with the actual facts. Taking the first totals and of thirty-one birds with which the results of inoculation are known, we find that only half as many died as we should expect from the average number of deaths already shown to follow inoculations, while twice the expected number recovered, and fifty per cent. over the expected number proved insusceptible. But, fortunately, it was shown by direct experiment that sixteen of these birds were for some reason particularly insusceptible; since, when the original lot of twenty was purchased, four taken at random were at once inoculated with active virus and not one of them sickened; they were subsequently inoculated at two different times, with very active virus, and still they remained in perfect health. They were not all so entirely insusceptible as this result indicated, however, since three of the sixteen in these experiments died and two sickened and recovered in spite of the supposed protective inoculation. The result with this sixteen, then, cannot be construed as favoring the supposition that any degree of immunity was conferred by the previous treatment.

With the remaining sixteen, of which we know the results, there is still a much smaller death rate (eight instead of twelve) than we should expect, and twice the number of recoveries and insusceptible birds. It must be remembered, however, that with so small a number we should not expect our results to be exactly in accordance with the average. Experiment No. 44 is more reliable than any or all of the others, for two reasons: the birds were from a lot known to be susceptible to the disease, and they received two injections, with four day's interval, of relatively large quantities of devitalized virus (pure blood). Not one of these escaped the disease, and two died from exceedingly acute attacks.

I conclude, therefore, that perfectly devitalized virus when injected in considerable quantity, at different times, and for two weeks before inoculation, does not increase the natural ability to resist this disease.

About the time these results were attained I learned that M. Toussaint had reached a similar decision in regard to anthrax; and that of twenty sheep inoculated at Alfort with his prepared virus, four had died and the remaining sixteen were sick but recovered.* His virus was not devitalized then, but its activity was diminished by subjecting it to the high temperature, and its protective influence depended upon the immunity conferred by a mild attack of the disease.

M. Pasteur maintains that he has obtained a mitigated virus of the *choléra des poules*, though at the time of making these experiments he had not yet made public the method by which this result was accomplished. We were encouraged, therefore, to continue our experiments in regard to the effect of temperature on the virus when the former was not quite sufficient to destroy the vitality of the latter.

24.—ATTEMPTS TO OBTAIN A MITIGATED VIRUS.

Experiments Nos. 35, 36, 37, and 38 were instituted with a view of determining the effect of as high a temperature as the virus can bear without destruction upon its properties. The result was not what was hoped in view of the effect of such a temperature on the virus of anthrax; indeed, not one of three inoculated with the virus heated to 130° F. for fifteen minutes was able to resist the disease thus induced, and all perished. Of the ten inoculated with virus heated to 124° to 130° F. but four survived, and these were insusceptible to the disease.

25.—PRESERVATION OF CULTIVATED VIRUS.

September 9 a flask of sterilized infusion of chicken muscle was inoculated by the process described further on in this report, by which means a pure cultivation of the granules of the virus was obtained; these multiplied and formed a very delicate membrane on the surface. October 26 this flask was opened and examined; it had almost exactly the same odor as when first filled, and there was no trace of putrefaction. To test the activity of the granules after being preserved for over six weeks, I made—

---

* H. Bouley. Inoculations préventives du Charbon, Bul. Acad. de Med. 1880, p. 943.

Experiment No. 48, *October* 26.—Two chickens inoculated by four lancet punctures each with liquid and particles of membrane from the cultivation flask.

November 1.—Yellow urates.

November 6.—One dies.

November 13.—The one remaining dies.

Three facts are very apparent from this experiment, viz: (1) the septic bacteria of the atmosphere had not been introduced or the solution would have become putrid, since it was kept for a part of the time in an incubator at 100° F.; (2) the granules seen in the blood had reproduced themselves; (3) they retained their vitality for a period of over six weeks.

Since the above was written the number of the *Comptes Rendus des séances de l'Academie des Sciences* for October 26, 1880, has come to hand, in which M. Pasteur details his process for obtaining a mitigated virus, and states that cultivations in contact with pure air do not entirely lose their activity in six or eight months, or even more, and that cultivations preserved from access of air retain their original virulence for certainly ten months, which is as far as his experiments go.

26.—SUSCEPTIBILITY INCREASED BY COLD WEATHER.

For about three weeks we have been having quite cold weather, the thermometer marking from 14° to 30° F. before sunrise, and I have noticed that during this time the period of incubation seems shorter, and the disease has a more acute form. One of the hens that had a severe attack of the disease and recovered, and which was still kept in an infected coop, died after a day or two of drooping and loss of appetite. Two chickens that had resisted two inoculations with very active virus, have also sickened, one dying November 20, and the other being still sick (November 22). It would seem, therefore, that for some reason the birds become more susceptible as the weather gets colder.

27.—RÉSUMÉ OF RESULTS ATTAINED BY THESE EXPERIMENTS.

It is demonstrated by these experiments that we have in the United States a contagious and inoculable disease of fowls, popularly known as chicken cholera; that this disease is characterized by a yellow or even greenish coloration of that part of the excrement which is separated from the blood by the kidneys; by elevation of temperature, enlargement and softening of the liver, congestion or inflammation of the intestines and mesentery; by diarrhea, drooping, sleepiness, and early death.* The germs of this disease are probably spread through the excrement,† and are taken into the body with the food and drink, and seldom if ever with the inspired air. The blood and tissue juices convey the disease either when inoculated or taken with the food; the bodies do not putrefy as rapidly as those which die from other diseases, and they certainly retain their virulence for thirty-six hours after death—probably much longer. The effect of putrefaction and drying on the activity of the virus was not determined, as the birds inoculated afterwards proved insusceptible to virus known to be active. Infected habitations convey the disease nine days, at least, after the last case of sickness. The period of incubation is much greater than with the disease known by the same name in France, averaging, with forty cases, fully eight days, as will be seen further on. The virus is not destroyed by a 20 per cent. solution of alcohol, by 2 per cent. of boracic acid and sulphate of potassium, by 1 per cent. of boracic acid, by 1 per cent. of carbolated camphor, nor by one-tenth per cent. of iodine. It is destroyed by 1 per cent. of salicylic, benzoic, or carbolic acids, and by one-half per cent. of sulphuric acid; and it is also destroyed by a temperature of about 132° F. maintained for fifteen minutes. One attack protects against the effects of subsequent inoculations; about one-third of the fowls inoculated prove insusceptible to the disease; hypodermic injection of considerable quantities of devitalized virus affords no protection, and, finally, heating to 130° F. or less for fifteen minutes has not modified the activity of the virus.

---

* See sections devoted to symptoms, etc.

† This point was not demonstrated.

SYMPTOMS.

The first symptom of fowl cholera is, in the great majority of cases, a yellow coloration of that part of the excrement which is excreted by the kidneys, and which is normally of a pure white; it is this part of the excrement that I have already, frequently, mentioned as the urates. This yellow coloring matter appears while the excrement is yet solid, while the bird presents a perfectly normal appearance, while the appetite is good, and before there is any elevation of temperature. Indeed, it is frequently seen the second or third day after inoculation, and then may disappear for a week or more, to return one or two days before the other symptoms of disease.

In a very few cases the first symptom is a diarrhea, the excrement being passed frequently and in large quantity, and consisting almost entirely of perfectly white urates.

In all cases the diarrhea soon becomes a prominent symptom, the excrement is voided frequently, consists largely of urates suspended in a thin, transparent mucus, and having a deep yellow coloration which may in the later stages of the disease change to a greenish or even deep green color.

With the beginning of the diarrhea the temperature rises, reaching 109° to 110° F., or two to four degrees above the normal; the comb loses its bright hue and becomes pale and bloodless; the appetite is lessened; the wings droop; the bird becomes inactive. Frequently a good appetite is retained to the last, but often the bird is overcome by stupor and sleeps away the last day or two of the disease; in such cases they are only aroused with difficulty, a touch or blow being required.

In the last stages of the disease they have lost greatly in weight, are exceedingly weak, fall over by a touch, and walk with the greatest difficulty.

Death frequently occurs without a struggle, but in the majority of cases there are convulsions and cries.

The duration of the disease varies greatly. Sometimes the bird dies within twenty-four hours after the first yellow coloration of the urates and when but one or two liquid dejections have occurred; in other cases life is prolonged for three, four, or five days, and occasionally for one or even two weeks.

The crop is generally distended with food and loses the ability to force this onwards to be digested; in all cases except those of the shortest duration the feathers about the anus become soiled with the discharges. If the birds are aroused from their sleep and made to walk, there is at first an abundant evacuation, followed at short intervals by scanty discharges, which, with the frequent contractions of the spincter ani, are evidence of considerable irritation of the posterior part of the intestinal canal.

In most cases the affected birds are very thirsty throughout the whole period of the disease; frequently, however, the thirst is not exaggerated, and in exceptional cases they scarcely drink at all.

When a bird is inoculated with devitalized virus, or when the subject proves insusceptible, a crust forms over the puncture and there is slight hyperæmia of the adjoining parts; but in a few days (four to eight) the redness disappears, the crusts fall off, and no trace of the puncture remains. This may also occur in exceptional instances, when a susceptible bird is inoculated with active virus. Usually, however, in the successful inoculations the crusts are larger and thicker, the redness of surrounding parts is more marked, the blood-vessels are more prominent; and this appearance may be retained for two or three weeks. Often the crusts fall off, leaving a slight elevation, which gives a sensation to the touch of a nodule more firm and resistant than the muscles in which it is situated.

PERIOD OF INCUBATION AND DURATION OF THE DISEASE.

In order to show at a glance the length of the period of incubation and the duration of the disease in individual cases as well as the average, I have prepared the following tables:

Incubation of 40 cases.		Death or recovery (2) of 45 cases.			
Days incubation.	Number of fowls.	Days after inoculation.	Number of fowls.	Days after inoculation.	Number of fowls.
4	4	5	1	16	4
5	2	6	1	18	1
6	7	7	3	20	1
7	6	8	2	21	1
8	9	9	7	23	1
9	3	10	7	27	1
10	4	11	3	32	1
11	3	12	5	Average 11 days.	
18	1	13	2	Average duration of disease, 3 days.	
20	1	14	3		
Average 8 days.		15	1		

The average duration of the disease in the above table is found by deducting the average period of incubation from the average time elapsing between the inoculation and either death or recovery. As there were but two recoveries recorded they do not modify the average of the fatal cases, particularly as one recovered in eighteen days and the other in twenty-seven days after inoculation.

POST-MORTEM APPEARANCES.

The comb is pale and bloodless, but neither dark nor dark blue, as seems to be the case in France. The superficial blood-vessels generally contain but little blood, and there are in most cases soiled feathers about the anus to which the excrement may adhere in considerable quantity.

On opening the body the first organ to attract the attention is the liver, which in nearly every case is enormously enlarged, softened, with blood vessels very apparent; often of a very dark or dark-green color, frequently attached to surrounding parts by false membranes, and as often surrounded by a transparent colorless effusion. In exceptional cases its appearance is nearly or quite normal. The gall-bladder is generally greatly distended with thick, dark bile, which has frequently passed through its walls in sufficient quantity to stain all of the organs in its vicinity.

The crop is generally distended with food, though no special lesions have been noticed here. The proventriculus, ventriculus, succenturiatus, or true stomach, viewed externally often presents a number of circular discolorations about one-tenth of an inch in diameter, which on section are found to be a small clot of extravasated blood. No lesions have been noticed in the gizzard. The small intestines are usually congested, often the mucous membrane is nearly black from engorgement of the blood-vessels, and occasionally the internal surface is the seat of ulcerations of various size and number. In one case a fibrinous plug had formed about midway of the small intestine completely obstructing the passage of the bowel contents; this plug was three inches long and very firm.

The rectum and cloaca generally present deep red lines upon their mucous membrane, evidently the first stage of inflammation, which results in chronic cases in thickening of the walls, especially of the rectum, the desquamation of the mucous membrane and the formation of large ulcerous surfaces. In some cases this thickening and ulceration extends into the colon; and it is generally seen in the chronic or sub-acute forms of the disease in the cæca, the walls of these being thickened, denuded of their mucous membrane and the cavity filled with a plug of coagulated lymph.

The mesentery is generally congested, often greatly thickened and rendered opaque by inflammation. The ureters are distended with yellow urates; the kidneys seem engorged, and on section accumulations of the tenacious, yellow urates are frequently seen. The spleen is generally normal in size and appearance, though frequently enlarged and softened.

The pericardium is sometimes distended with effusion, in which cases there is noticeable hyperæmia of the surface of the heart.

The lungs are often, though not generally, engorged with dark blood; they are seldom if ever hepatized.

The blood-vessels are sometimes filled with a firm clot, and contain but little liquid; at other times the blood does not coagulate at all. It seems to be those cases where the duration of the disease has been longest in which the blood loses its property of coagulation.

In the few cases examined by me in which the disease was contracted from infected premises, &c., the lymphatic glands along the neck appeared much more congested than in cases which resulted from inoculation, indicating, as suggested by Toussaint, that the virus had been taken with the food and absorbed from the mouth or pharynx.

The brain, in the cases examined, has been either normal or not very perceptibly altered.

The muscles at the seat of inoculation are generally reddened, though sometimes perfectly normal; in a few cases, at the point of inoculation, the tissue has been transformed into a whitish, rather firm substance, without definite outline, but disappearing imperceptibly into the substance of the muscle; exceptionally, this has divided from the muscular tissue, and exists as a clearly circumscribed sequestrum.

MICROSCOPICAL INVESTIGATIONS.

When the blood from a fowl just dead of cholera, or on the point of dying, is placed under a one-tenth objective or better under a one-fifteenth, a number of peculiarities are observed. The red globules which should be provided with nuclei are mostly without these; and such nuclei are found free, either singly or in clusters, in various parts of the field. There are many globules resembling the red corpuscles in color and appearance, but which are smaller, circular or irregular in form. There are aggregations of spherical, oval, and rod-shaped granules, both clusters and granules varying somewhat in size; there are free granules, spherical in form, of exceedingly small size ($\frac{1}{40000}$th of an inch in diameter), and without motion or in certain cases with simply a molecular (Brownian) motion, and finally there are bodies of a larger, but varying, size, not numerous, transparent and apt to be overlooked; they may be seen apparently in various stages of division. Figure 9 is a drawing from the blood taken from a vein just before the death of the bird and examined as soon as possible; the different changes already mentioned may be observed.

With the exception of the bodies last mentioned, the appearance of the blood in this disease was accurately described by Professor Perroncito, of the Veterinary School of Turin, in a paper presented to the Royal Academy of Agriculture of Turin, in February, 1878; also by M. Méguin, in a communication to the *Recueil de Médecine Vétérinaire*, in January, 1880.

In the present state of uncertainty regarding the nature of the contagion in such diseases, a careful study of the condition of the blood, especially when as virulent as in the disease under consideration, becomes a matter of primary importance, and for this reason I shall enter into some detail regarding the phenomena mentioned.

1. *The free nuclei.*—These are mentioned by Perroncito, without comment as to the cause of the phenomenon; Méguin does not so much as mention them, but figures each of the red corpuscles with its nucles. Nevertheless, in nearly every ordinary preparation of blood I have made, the majority of the red corpuscles were without nuclei, and these were to be found free in various parts of the preparation as seen in Fig. 9.

By the use of osmic acid, however, I was able to demonstrate that the escape of the nuclei occurred either after the death of the bird or after the blood was taken from the veins. Osmic acid has been found of the very greatest service in these investigations; if a drop of blood is placed on a thin cover and immediately inverted for a minute or two over a two or three per cent. solution of this acid, the fumes destroy every vestige of life, and no changes take place for an indefinite time.

Figure 14 is a drawing from such a preparation; here there are no free nuclei, and every red corpuscle has its nucleus in its proper position. By delaying a minute or two before exposing the blood to the influence of this agent, examples may be found illustrating the escape of the nucleus as is shown in Fig. 13.

The escape of the nucleus is evidently, then, what we might call a post-mortem change; at least it does not occur until the vital influences of the living body are no longer exerted upon it, but within a few minutes after the blood is taken from the veins or after the death of the bird. This phenomenon, however, is not peculiar to chicken cholera, but occurs to the same degree and under the same circumstances in the blood from healthy fowls, as I have assured myself by numerous observations.

2. *The so-called hematoblasts.*—Both Perroncito and Méguin speak of the globules, which are generally irregularly round or oval, and smaller than the red corpuscles, and which resemble these in color, as young or proliferating globules (hematoblasts). On the contrary, I think my observations prove them to be the *débris* of red corpuscles destroyed by leucocytes. In watching the movements of the clusters of granules shown in the figures, I found that they were, evidently, leucocytes, though the homogeneous bioplasm was so transparent as to be generally invisible. These leucocytes would move from one red globule to another, and the latter, soon after coming into contact with them, would become distorted in form and break up into globular particles. The leucocyte could be plainly seen in many instances, passing entirely through the red globule and severing it into two or more particles, which assumed the round or oval form. Figure 16 is an exact reproduction of the appearance of this phenomenon. It would seem that the leucocytes feed upon some of the constituents of the red globules; but, as far as I have observed, this, too, occurs after the blood is taken from the veins or after the death of the bird. I know of no evidence leading to the belief that such particles of red globules are living, or that they could in any way grow and again form perfect globules.

3. *The granular bioplasm.*—Early in my investigations my attention was called to the large number of clusters of granules to be seen in the blood; sometimes these granules were spherical, sometimes oval, and often rod-shaped. In the last form they resembled diminutive *Bacilli.* At first I did not suspect that the granules of these clusters were in any way connected with each other; the $\frac{1}{15}$ Tolles objective with excellent illumination did not enable me to make out any homogeneous connecting substance. I wish to insist upon this fact, because recent investigators, in their zeal to establish a particular theory, have declared that, because they did not see particles of bioplasm, these did not exist; and in their cultivations, because they only saw a particular form, no other could be present. When the whole medical world is divided over the question concerning the nature of contagia, as is now the case, such assertions, no matter by whom made, cannot be received as evidence; on the other hand, they must be regarded by thinking men as an attempt to impose upon the confidence or credulity of the reader.

But to return to our clusters of granules. The granules did not move individually, but the whole cluster could at times be seen to change form (Fig. 11). They would assume an oval, round, or dumb-bell shape, then a projection like an arm would be seen to extend itself in a certain direction; at the extremity of this an enlargement would form, which would increase in size until it would become the body of the cluster, and only a narrow arm would extend in the direction of the original cluster. In this way the clusters not only changed form, but they shifted their position, and in a few minutes would move nearly across the field of vision. Coming in contact with a red globule, this would quickly become deformed; the granules would pass through it in various directions, dividing it into two, three, four, or even more parts, which would generally assume a globular form, and become the hematoblasts already mentioned.

These movements of the clusters, plainly amœboid, led to the conclusion that the granules were connected by a homogeneous, invisible bioplasm, that in fact they were the granules of leucocytes; fortunately, I was able to prove this. By exposing portions of the blood on the thin cover-glass to the fumes of osmic acid, these leucocytes were not only killed, but they became visible, and then presented the appearance seen in Fig. 14. There were now many leucocytes visible where their presence was not before suspected; their outline had become plain, and within the homgeneous bioplasm could be seen the granules.

A more careful examination led me to observe that at the center of the preparation the granules were round or oval, while nearer to the edges of the cover-glass, where there was a better supply of atmospheric oxygen, they had the rod form, and the movements of the leucocytes were more pronounced. The rods were $\frac{1}{56000}$ to $\frac{1}{25000}$th of an inch in length, by $\frac{1}{50000}$th or less in diameter.

4. *The free granules.*—The presence of these was first noticed by Perroncito, in the paper already referred to, and they have since been studied by both Toussaint and Pasteur. These granules are much more numerous in blood taken from the body after death than in that examined during the life of the bird; and, again, they seem less numerous the sooner the blood is examined after being taken from the veins during life. I have noticed that in my best osmic-acid preparations of blood, from the living bird, free granules could scarcely be found.

The granules are extremely small, $\frac{1}{35000}$ to $\frac{1}{50000}$th of an inch in diameter. Some are perfectly spherical; many others show all gradations of a division by fission—first a slight constriction, then advancing more and more toward the dumb-bell form, and, finally, existing as two granules just touching at a point of their circumference.

Granules exactly the same in appearance are seen either on the surface or within the red globules and surrounding the nuclei; they are, also, seen within the leucocytes. Again, one frequently meets granules of the same appearance and in equal number in the blood of fowls supposed to be healthy.

Toussaint and Pasteur have each succeeded in cultivating these granules in suitable solutions. I have also cultivated them by two methods, as follows:

a. Cultivation on slides.—A rather deep glass cell is cemented on an ordinary slide and a drop of distilled water run around within it, next to the wall, to furnish moisture. An ordinary thin cover-glass is carefully flamed and a drop of infusion of chicken muscle well filtered and sterilized by heat is placed on its center; the drop of infusion is next inoculated by touching with the point of a recently heated needle just dipped into the blood. Finally, the thin glass-cover is inverted over the cell and a ring of paraffin, or, what is better, the paraffin-imbedding mixture, is run around it. The slide is then kept in an incubator at 106° F.

If the blood used for the inoculation has been properly obtained, the preparations are seldom invaded by septic organisms. An excellent method of obtaining pure blood is to kill a bird in the last stages of the disease by strangulation, then expose the heart by removing the breast bone, select a capillary vacuum tube with a finely drawn out extremity, and, after flaming it, force through the walls of one of the large vessels near the auricle; break the point across the walls of the vessel, and when entirely filled seal quickly in the flame of a lamp. When to be used for inoculation as above, the tube is again flamed, the point broken, and the needle touched to the blood still within the tube.

In such cultivations the granules multiply rapidly, form zooglœa masses, and, finally, a delicate membrane on the lower surface of the drop. Preparations thus made may be kept under observation one or two weeks without difficulty.

I prefer this arrangement of the slide for such cultivations, but there are two objections to it: 1. The thickness of the drop and the multiplication of the granules at its lower surface prevents examination with the highest powers except at its border. 2. The drop of water forming a plano-convex lens, the rays of light are broken and a distorted image is liable to result. For this investigation I have concluded from observation that the second objection is not valid, and that the former is not a serious drawback. Both may be overcome, however, either by using Raurier's cultivation slide, or, as suggested to me by Mr. Charles Stodder, by laying a smaller piece of thin glass on the drop after inoculation; this cuts off the access of air to a certain extent, and, consequently, I have preferred the uncovered drop in practice.

Cultivations on slides are, after all, open to the grave objection that they cannot be prepared without contact with the atmospheric air, and the possible if not probable admission of some of the germs continually floating in it in such vast numbers. Nearly every investigator has been so troubled in this way that the results of his work have been unreliable, if not positively worthless. Is there not some method, then, by which a cultivation may be made without the possible admission of such germs? After a long consideration of this question, I believe I have succeeded in producing an apparatus, by modifying and combining certain points in the methods of other investigators, that answers the conditions as well as could be expected, and that can be arranged from the materials found in any laboratory. It is described in the next paragraph.

b. Cultivation in flasks.—A small German flask, Fig. 19, *A*, of two to four ounces capacity, is fitted with a soft rubber cork pierced with two holes; through one of these passes a glass tube, *e*, $\frac{3}{16}$ inch in diameter, bent twice at right angles, and packed loosely near its outer extremity, *f*, with cotton-wool; through the second hole passes a tube bent once at a right angle, and just beyond at *d* drawn down to about half its previous diameter, and, again, just beyond this constriction, drawn to a sealed point, *c*. One end of a piece of caoutchouc tubing fits over the point *c*, which is here shown in section, while into the other end is placed a fine aspirator needle, *b*; and, finally, a short piece of glass tubing, *a*, sealed at one end and packed with cotton wool is slipped over the needle. In using, the infusion for the cultivating medium is introduced into the flask, the cork is tightly replaced, and the whole apparatus is placed in a dry chamber that can be kept for several hours at 212° F.; after cooling it is allowed to stand for three or four hours, and again heated for one or two hours, and this may be repeated the third time, as is my practice. By this intermittent heating not only the germs in the liquid but in the tubes as well are destroyed.

To charge the infusion thus prepared with virus, a pair of aspirator jars—such as were used by Cohn* in his investigations of bacteria—are attached by caoutchouc tubing *g* to the open tube at *f*; then a large vein in a very sick fowl is laid bare, and a thread passed around it, the glass cap *a* is removed from the needle and this is quickly forced into the vein and the thread well tied around it; finally, the point of the glass tube *c* is broken within the caoutchouc tube by pressure across its walls, and the clip *h* on the tube between the aspirator jars is opened. As soon as a few drops of blood have reached the flask the clip *h* is closed, and the glass tube is severed at the constriction *d*, and at the same time hermetically sealed. Now, removing the aspirator, we have a flask that contains the sterilized infusion inoculated with perfectly pure blood, and this is supplied with pure air which enters through the ventilator *e*, packed with cotton-wool, to filter out all atmospheric germs.

---

*Beiträge zur Biologie de Pflanzen B. I., H. III, p. 148.

The whole may be placed in an incubator at the desired temperature for any length of time before examining.

By means of this apparatus I have succeeded in obtaining the granules of chicken cholera in large quantity. They multiply rapidly, render the liquid turbid, and finally form an exceedingly delicate membrane on the surface which consists entirely of granules. The membrane on the surface of a flask prepared September 3 was used for the inoculation of two birds October 26, and produced unmistakable cases of the disease, ending in death November 6 and 13.

Any number of generations of pure virus may be cultivated in these flasks without the slightest difficulty; to accomplish this other flasks are prepared as directed for the first generation, with a single exception; in place of the aspirator needle *b* is inserted a short section of glass tubing, sealed at both ends to close the orifice. To inoculate this new flask the point *d* of the original one is well flamed, the point *b* of the new flask is also flamed, the glass tube removed, and the point *d* inserted in its stead; the aspirator jars are now connected with the new flask, the sealed points broken within the caoutchouc tube, the clip *h* opened, and the second infusion receives the virus with the same purity as the first.

I believe the apparatus just described, and which is not so complicated as would appear from the long description, will prove of very great use in investigating other contagious diseases, and may settle points which up to this time have been disputed.

5. *Bodies of undetermined nature.*—These were first noticed in the liquid part of the excrement, in which they existed in immense numbers and of all sizes, from $\frac{1}{100000}$ to $\frac{1}{8000}$ of an inch in diameter, Fig. 17; bodies of similar appearance have since been found in the blood, Fig. 18, and I think I have also made them out in my cultivations, but not with the same certainty. They are not easily discovered, and it was not till within the last few weeks that my attention was directed to them. I have not yet been able to determine their nature or their relation to the disease.

PART III.—INFLUENCE OF RECENT INVESTIGATIONS ON THE THEORIES OF CONTAGIA.

In the two preceding parts I have endeavored to give a detailed report of my most important researches without drawing other than the plainest conclusions from them; but the duty of the investigator does not stop here—others have studied these and similar diseases, and they have constructed theories, some of which oppose while others confirm my own results. And in a time when scientific methods are so justly relied upon in our search for the truth, as at present, no one who really desires .the speedy success of those doctrines which are in accordance with the facts, can ignore the work of his predecessors. There is, consequently, a duty devolving upon the writer of such a report, which any one, realizing the difficult nature of the subject, would rather defer until more definite investigations had marked out a plainer course. But if the field is not yet clear, it is, nevertheless, a matter of great importance for us to review the more important evidence, and to reach clear ideas as to what is known, what is yet doubtful, and what seems to be contrary to well ascertained facts.

I.—THEORIES OF CONTAGION AND WHAT IS REQUIRED TO ESTABLISH THEM.

There are three principal theories in regard to the nature of that substance which, transferred from the body of an animal suffering from a contagious disease to the body of a healthy one, produces the same malady in the latter as affects the former.

1. It is considered by some as an unorganized ferment, allied perhaps to diastase, which has the power of producing zymotic changes in the blood and other liquids of the healthy body.

2. By others it is looked upon as a modified form of the living matter—the bioplasm or protoplasm, as it is called, of the body. There are two forms of this theory: *a.* The virus is in the form of naked particles of bioplasm of various sizes and forms, identical in all but vital powers with the leucocytes or wandering cells of the healthy body. *b.* The virus consists of granules of bioplasm, endowed with peculiar vital powers, which leave the wandering cells, and perhaps the protoplasmic contents of other cells, and multiply in the blood and other fluids, constituting the micrococci so frequently, I might say generally, seen in these affections.

3. According to the third theory the virus is a parasitic organism originating outside of the body but capable of growth and multiplication within it. It probably consists of the lowest forms of vegetable life known as the *schizomycetes*, *schizophytæ*, *bacteriaceæ*, or more simply as *bacteria*. There is also a second form of this theory which considers the bacteria as the developed granules or plastids formed in the bioplasm of the higher orders of fungi.

1. *The theory of unorganized ferments.*—The first step toward establishing this theory evidently consists in showing that the conditions of existence of the contagia are different from those of living matter in any form. Panum's[*] experiments with putrid substances are still accepted by some[†] as proof that contagia are not living matters, since he proved that a putrid infusion might be boiled eleven hours without losing its activity. Von Raison even found that it resisted several hours' heating to 130° C[‡]. M. Paul Bert observed that compressed oxygen, which he supposed would kill all living things, did not destroy the virus of glanders and vaccine, even when the pressure was equal to fifty atmospheres for a week[§]. He supposed that he had proved the same true of anthrax virus,[||] but Pasteur convinced him that he had mistaken septicæmia for anthrax and that the germs of the septic vibrio remained unharmed even after subjection to the action of compressed oxygen and absolute alcohol.[¶]

The only successful attempts at isolating such unorganized ferments, that I am acquainted with, have been made with septicæmia and putrid poisoning. Panum isolated a putrid extract and a narcotic substance. Dr. Richardson, in 1865, showed that the sero-sanguineous fluid from the peritoneal cavity of a person suffering from pyæmia would communicate fatal disease from one animal to another in a direct series, and that the poison (designated "septine"), which effected this, could be made to combine with acids so as to form salts, which retained the poisonous qualities of the original substance.[*] In 1868, Bergmann and Schmiedeberg[†] isolated a substance called sulphate of sepsin; in 1869, Zuelzer and Sonnenschein obtained a septic alcaloid similar to atropin[‡], while Hiller[§] discovered a septic ferment.

---

[*] Panum, Das putride Gift. Virchow's Archiv., B. 60 (1874), p. 334.

[†] T. R. Lewis, Quarterly Journal Mic. Science, 1879, pp. 402–3.

[‡] Hiller, Lehre von der Fäulniss, Berlin, 1879, p. 182.

[§] Recueil de Médecine Vétérinaire, 1877, p. 546.

[||] Loc. cit., p. 547.

[¶] Loc. cit., p. 919.

I pass over in silence the many other experiments by filtration, diffusion, dialysis, etc., which establish the same fact, viz., that there exists in putrid substances a poison of complex nature, allied to the alcaloids, and not having the properties of a living substance. The bearing of this fact on the doctrine of *contagium vivum* (and in this term I include both the remaining theories) will be discussed when we come to consider the nature of septicæmia.

Notwithstanding the experiments of M. Bert in regard to glanders and vaccine virus, this theory is at this time quite generally deemed insufficient, because an unorganized ferment is incapable of multiplying itself indefinitely; such a substance may cause the decomposition of a definite quantity of matter, but we have no proof that it can reproduce itself, and thus, like the living ferments, produce the decomposition of an indefinite amount of the substance to which it is added, and no fact is better known than that the true contagia have the power to reproduce themselves indefinitely, if placed in a suitable medium.

Again, it would seem that such a ferment ought certainly to resist a temperature of 140° F. (which destroys both chicken cholera and fresh anthrax virus), as, also, one-half per cent. of sulphuric acid, or one per cent. of carbolic, salicylic, or benzoic acids, which destroy fowl cholera virus.

Finally, M. Chauveau[‖] has shown with several diseases that the activity of the contagion resides in elementary corpuscles, which are suspended in virulent liquids; that these corpuscles may be washed without losing their specific properties, and that they do not communicate virulence to water by remaining in it for prolonged periods. These facts are in direct opposition to the theory of a soluble poison or unorganized ferment.

2. *The theory of bioplasm or its granules.*—In all contagious fevers there are local inflammations, and in inflammation, no matter how produced, there is an abnormal increase of the bioplasm of the part, both by the influx of vast numbers of wandering cells and by the multiplication of the nuclei of the tissues.

The physiological existence of granules capable of reproduction was assumed by Darwin in order to explain the facts of inheritance. He supposed the living cells of the body throw off minute granules or atoms which circulate freely through the system, multiply by self-division, and are subsequently developed into cells like those from which they are derived.[¶] Later, Beale figured vast numbers of small particles of living matter (bioplasts) which he supposed constituted the virus of cattle plague, vaccine, etc.: "The minute contagious bioplast," he says, "is less than the $\frac{1}{100000}$th of an inch in diameter and often so very clear and structureless as to be scarcely distinguishable from the fluid in which it is suspended."[**] Quite recently it has been shown that certain kinds of cells allow granules of protoplasm to wander from them under certain physiological conditions, and that these granules are not to be distinguished in appearance and reaction to coloring matters, at least from those found in contagious diseases, and termed micrococci.* In both swine plague and fowl cholera I have observed what appeared to be similar swarming of granules, but I have not yet been able to determine if such granules are identical with those which multiply in the cultivation liquids, or if either constitute the virus of these diseases. We may, by filtering experiments, decide that the contagion consists of solid particles, but to determine the nature of these is a much more difficult question.

---

[*] Referred to by Dr. Lewis, Quart. Jour. Mic. Sc. 1879, p. 403.

[†] Centralblatt für die medicin. Wissenschaften, 1868, p. 397.

[‡] Berliner klin. Wochenschr. 1869, p. 121.

[§] Lehre von der Fäulniss, p. 188.

[‖] Recueil de Médecine Vétérinaire, 1872, pp. 898–9.

[¶] Animals and Plants under Domestication, II, p. 448.

[**] Disease Germs, p. 243.

There is a different line of experimenting which seems to support the view that the contagious particles are formed from the normal constituents of the living body. Hiller,† in 1872, showed that the products of inflammations produced by chemical agents were of a contagious nature, and might be successfully inoculated. Burdon-Sanderson has shown that exudation liquids, even in extremely small quantity, when mixed with the blood stream produce pyrexia,‡ and, also, that acute inflammations produced by physical or chemical means are transmissible.§ Lewis and Cunningham have, also, shown "that the living tissues of the body will, under certain conditions, when irritated by means of purely chemical irritants—such for example as a strong solution of iodine or liquor ammonia—secrete a fluid which, transferred from animal to animal, proves not one whit less virulent in its properties than an exudation which has resulted primarily from the introduction into the system of material which has swarmed with bacilli."‖

3. *The bacteria theory.*—In this section I shall confine myself to the forms, distribution, and peculiarities of the schizomycetes, and to certain general facts bearing on the question, in order to show what kind of evidence is necessary to demonstrate their pathogenic action. The observations in regard to their relation to contagious diseases will be more conveniently considered in the study of certain virulent diseases.

a. The nature, form, and classification of the bacteriaceæ.—Comparatively recent investigations have shown that in all putrefying animal and vegetable matters are to be found vast numbers of exceedingly minute organisms, existing either in the form of filaments (threads), or granules (spherical or oval), and that if these are excluded such matters may be preserved indefinitely. These organisms are emphatically the lowest forms of life, and are probably of a vegetable nature, though in many cases capable of the most active movements. When we examine with the microscope an infusion of meat that has commenced to give off offensive gases, we find that there are a variety of forms to be observed under powers of 500 to 1,000 diameters; there are spherical and oval granules, frequently of different sizes; plain stiff rods, jointed or single, varying in diameter from $\frac{1}{20000}$th to $\frac{1}{40000}$th of an inch, some moving and others perfectly motionless; other rods containing very apparent round or oval granules; filaments, short or long, flexible and moving by an undulating, wavy, vibratory or screw-like motion, and even filaments coiled in a spiral form. These are the *schizomycetes* of Nägeli, the *schizophytæ* of Cohn and the *bacteriaceæ* or bacteria of most writers; they are the active agents of putrefaction, and without them no decomposition of this nature can occur;¶ putrefaction in reality consists in the assimilation of certain substances which are proper for the food of these organisms, and its decomposition by the living matter within them; it is exactly analogous to the assimilation of food by the higher animals, and the decomposition of this into both gaseous and solid parts which occurs in the animal body, as a consequence of the activity and growth of its living constituents.

---

* G. & F. E. Hoggan, Jour. Roy. Mic. Soc., 1879, pp. 375 to 380.

† Lehre von der Fäulniss, p. 1[illegible]5.

‡ Veterinarian, 1873, pp. 719-20.

§ On the Infective Product of Inflammation. Lancet, 1873, No. 21.

‖ T. R. Lewis, Quart. Jour. Mic. Science, 1879, p. 103.

¶ F. Cohn, Beiträge zur Biologie der Pflanzen, II, 1872, p. 203.

This much understood, any one is prepared from personal observation to appreciate the immense number and wide distribution of these organisms, for all know how soon an animal body, a piece of meat, or even vegetable matters become putrid if kept in certain conditions of heat and moisture.

With the exact place of these organisms in nature we have not much to do; such studies are the work of the naturalist, not of the pathologist, but it is well for us to know the widely different opinions that have been entertained in regard to them. They were formerly thought to be of an animal nature, but now most authorities consider their place to be in the vegetable kingdom, though some go so far as to create a new kingdom between the animal and vegetable to which they are consigned.[*] Hallier[†] has long taught that they are simply the developed granules of protoplasm or plastids of different varieties of fungi; Karsten[‡] and Grimm[§] believed they may be formed from the granules of animal protoplasm by the breaking up of the cells containing this.

When we come to consider the classification of bacteria we are again confronted by the same unsatisfactory state of the knowledge concerning them. Billroth[‖] maintains that all of the different kinds of bacteria are simply vegetation forms of the same organism; the granules he calls *coccos* and the filaments *bacteria*. According to the diameter the former are divided into *micro-*, *meso- and mega-coccos*, and the latter into *micro-*, *meso- and mega-bacteria*. These elements may exist singly, in pairs, or in chains, and for these he proposes the terms *monococcos*, *diplococcos*, and *streptococcos*, and *monobacteria*, *diplobacteria*, and *streptobacteria*. During multiplication a mucus-like matter (glia) is secreted, and as the growth occurs particularly on the surface of liquids, a thin, cohesive membrane is the result; this, when formed of granules, is called *petalococcos*, and when of filaments, *petalobacteria*. The granules multiply to a certain depth in the liquid, by which means flocculent, cloudy masses are produced, which he calls gliacoccos; this term being synonymous with the zooglœa of F. Cohn. Now these different forms, though growing either as coccos or bacteria for a number of generations, are looked upon as capable of changing or developing from one to the other, and the several forms specified are considered as constituting but a single organism, which he calls *Coccobacteria septica*.

Nägeli's[¶] views in regard to the classification of bacteria approach somewhat those entertained by Billroth; while he holds it still necessary to speak of the different forms as micrococcus, vibrio, bacterium, and spirillum, he says he cannot assert that there is any necessity for dividing them into even two specifically different forms.

---

[*] Ant. Maguin, Les Bactéries. Paris, 1878, p. 42.

[†] Hallier, Die Pflanzlichen Parasiten des Menschlichen Körpers, Leipzig, 1866. **Also** Die Plastiden der niederen Pflanzen, etc., 1878.

[‡] Die Plastiden der niederen Pflanzen, Leipzig, 1878, p. 79.

[§] Veterinarian, 1874, p. 163.

[‖] Dr. Th. Billroth, Uuntersuchungen über Vegetations Formen von Cocobacteria Septica, etc., 1874.

[¶] Die niederen Pilze in ihren Berziehungen zu den Infectionskrankheiten, etc. München, 1877, pp. 20 to 24.

Davaine's[*] classification as a means of distinguishing the different forms has been quite widely adopted in practice and is perhaps the simplest of all; it is as follows:

1. Filaments straight or bent, but not twisted into a spiral.			2. Filaments twisted in a spiral form.
A. Moving spontaneously.		B. Immovable.	
a. Rigid.	b. Flexible.		
Bacterium.	Vibrio.	Bacteridium.	Spirillum.

The views of Cohn are very different from those of Billroth and Nägeli. He says: "I consider myself authorized, where to a certain bacteria-form peculiar physiological phenomena are constantly bound, particularly if this is a specific fermentation, to look upon the same as a substantial species, even if under the microscope I am able to perceive no other distinguishing mark."[†] Pasteur also regards as a particular species such forms as constantly arise in a special medium or which cause a certain specific fermentation.[‡]

The objections of Nägeli to such views are founded upon the following observations: In the first place, he has noticed, in the same decomposition, the presence of several different forms of *schizomycetes*; again, in decompositions entirely different one may observe *schizomycetes* exactly alike according to their external form, and, finally, the physiological action of a particular form may be changed by causing it to undergo certain treatment. For this author and investigator, who certainly ranks among the highest authorities, the form and action of bacteria are probably due to a sort of acclimatization, and these change with different conditions of life. Not only may each species assume the forms of micrococcus, bacterium, vibrio, and spirillum, but each is also capable of causing lacteal acid formation, putrefaction, and different forms of disease.[§]

Most pathologists, however, seem inclined to adopt the views of Cohn. This is especially true of Koch,[||] whose great ability in this class of investigations is now universally admitted. He concludes that there is an internal difference in the pathogenic bacteria, and that the particular forms of the different kinds are constant. Each variety of septic disease represented a particular bacteria-form, which always remained the same no matter how many times inoculated. These forms are well characterized by their size and shape, as well as by their physiological effects and manner of growth. There are, consequently, bacteria which are pathogenic and those which are not pathogenic.

The tendency of the most recent investigations seems to favor the views of Cohn and Koch. Thus, the contagium of charbon—the *Bacillus anthracis*—always exists in the blood and tissues during life in the form of rods, while after death these rods grow to long filaments and form spores; but these spores are very different from micrococci. They do not multiply by fission and form gliacoccus masses, and they resist external conditions (temperature, &c.) that would be fatal to true micrococci. In other words, this organism has fixed vegetation-forms, through which it develops, and in which alone it exists. Chicken-cholera virus also exists in a particular form—that of granules or micrococci—and it has never been seen to develop into any other form. The septic vibrio of Pasteur and the different pathogenic organisms studied by Koch each have a definite method of reproduction and development, from which they do not depart. The idea that septic bacteria may be transformed into the contagious germs of other diseases than septiæmia—that is, that such maladies may arise spontaneously by exposure to filth and to the products of organic decomposition—may be said to be losing ground, and the view now most generally adopted by leading thinkers is that every case of such disease arises from germs that have been produced by a previous case of the same disease.

---

[*] Quoted by Richardson in Handbook of Medical Microscopy, 1871, p. 104.

[†] Beiträge zur Biologie der Pflanzen, II. III, 1875, p. 142.

[‡] Magnin, Les Bactéries, p. 49.

[§] Die niederen Pilze, etc., pp. 22–24.

[||] Dr. Robert Koch, Untersuchungen über die Aetiologie der Wundinfectionskrankheiten, Leipzig, 1878.

Among this great variety of conflicting opinions it is impossible at present to make a satisfactory choice. This is the first difficulty in our present study. Admitting the bacteria theory of contagion to be correct, are we to expect to find a particular bacteria-form in each contagious disease, or may the contagion exist under the various forms of micrococcus, bacillus, vibrio, or spirillum?

Even if we find the virus is always constituted by a particular form of organism, it seems impossible to leave entirely out of consideration the physiological peculiarities; for the classification by form alone must of necessity be extremely unsatisfactory. For instance, the spherical bacteria may exist all the way from $\frac{1}{50000}$th of an inch, or even less, up to $\frac{1}{20000}$th of an inch in diameter, and supposing we could accurately measure each $\frac{1}{100000}$th of an inch (which we cannot), at what points are we going to make our limits for each variety? The same argument applies with the same force to the *Bacilli*. We will take an example. Dr. Detmers, in his investigations of swine-plague, found a particular *Bacillus*, which he describes, and which he has gone so far as to classify into a separate variety, that he calls *Bacillus suis*.* It is about $\frac{1}{35000}$th of an inch in diameter and $\frac{1}{4000}$th to $\frac{1}{5000}$th of an inch in length. In examining specimens of dew and well water, which had an opportunity, he thinks, to become infected through the air, he found what he supposed was the same *Bacillus*. Now, the question is, can the dimensions of these *Bacillus* rods be taken as always indicating this variety?

Within the last thirteen months I have carefully examined over one hundred putrefying solutions and I have found in the great majority of them, at some period of putrefaction, a *Bacillus* of exactly these dimensions, and that in a section of the country entirely free from swine plague; I have gone farther and inoculated pigs with one or two cubic centimeters of the liquids swarming with such *Bacilli* without producing the least results. We must conclude, therefore, that there is a septic bacterium having these dimensions, and we may ask what certainty can there be that the dew or water did not contain this and not the swine plague contagium?

Again, it may be asked, who would undertake to distinguish by appearance and measurements alone between *Bacillus subtilis*, *Bacillus anthracis*, and *Bacillus amylobacter*? Even so good an authority as M. Pasteur, who has made a specialty of such studies for more than twenty years, recognizes to such an extent the difficulty of determining the species of bacteria that he writes: "I have generally abstained from giving specific names to such of these organisms as I had reason to believe were new."†

Taking into considertion then the confusion which still exists in regard to the classification of the *schizomycetes*, and the difficulty of determining between many of those varieties which have been best studied, we can appreciate the importance of knowing something of the distribution of these organisms in nature, and of learning to just what extent we are liable to meet with them outside of the tissues and fluids of animals affected with contagious diseases.

---

* Department of Agriculture Report, 1878. † Comptes Rendus lxxxviii, 1879, p. 1214.

Since writing the above, one of the most satisfactory classifications of the genera of the Bacteriaceæ that I have yet seen has come under my eye, and I insert it as the latest contribution to the subject.*

I. Cells not united into filaments, separating immediately after division, or in couples, free or united into colonies (Zooglœa) by a gelatinous substance.
  A. Cells dividing in one direction only.
    α. Cells globular: *Micrococcus.*
    β. Cells elliptical or shortly cylindrical: *Bacterium.*
  B. Cells dividing regularly in three directions and thus forming cubical families, having the form of pockets strung crosswise and consisting of 4, 8, 16, or more cells: *Sarcina.*
II. Cells united into cylindrical filaments.
  A. Filaments straight, imperfectly segmented.
    α. Filaments very fine and short, forming rods: *Bacillus.*
    β. Filaments very fine and very long: *Leptothrix.*
    γ. Filaments thick and long: *Beggiatoa.*
  B. Filaments wavy or spiral.
    α. Filaments short and stiff.
      a. Filaments slightly wavy, often forming woolly flocks: *Vibrio.*
      b. Filaments spiral, stiff, moving only forward or backward: *Spirillum.*
    β. Filaments long, flexible, with rapid undulations, spiral through their whole length, and endowed with great mobility: *Spirochæte.*

b. Distribution of schizomycetes in nature.—Dr. Burdon-Sanderson has shown that the spores or germinal matter of bacteria are universally present in water,† and with the assistance of Professor Tyndall he demonstrated their presence in the heart of the clearest blocks of Norway ice.‡ The presence of bacteria in distilled water was pointed out by Tyndall,§ and in my own investigations I have had occasion to confirm this only too often; indeed, it has been almost impossible for me to keep such water free from them for more than an hour or two after distillation.

In regard to the presence of bacteria or their germs in the air, there has been a greater difference of opinion, but the later investigations have removed all doubts. Tyndall, from his experiments, concludes that the air contains vast numbers of them. "There are billions of them," he says, "in every ordinary London room."‖ Beale¶ and Hiller** also insist upon this fact, while Miguel,†† the most recent investigator, has succeeded in counting such germs, and has frequently found as many as one thousand in a cubic meter of air; but the number varies greatly with the season of the year, the moisture of the atmosphere, &c.

It is plain from the above observations that the food and drink, and even the air inspired, are bearers of bacteria into the bodies of every living animal. Tyndall‡‡ has even shown that the lungs retain these germs, and that the expired air is perfectly free from them; while many observers have met with bacteria in immense numbers in the mouth and

---

[*] Dr. Luerssen, Rev. Internat. Sci., iii, p. 242, quoted in Jour. Roy. Mic. Soc., 1880, p. 837.

[†] John Tyndall, Fragments of Science, p. 23.

[‡] Loc. cit., p. 21.

[§] Loc. cit., p. 23.

[‖] Loc. cit., p. 21.

[¶] Microscope in Medicine, 1878, pp. 317, 318.

[**] Lehre von der Fäulniss, p. 145.

[††] Comptes Rendus, xci, 1880, p. 64.

[‡‡] Loc. cit., pp. 2, 3.

alimentary canal in health as well as in disease. H. T. Butlin[*] has lately found in the mouth micrococcus, *Bacillus subtilis*, *Bacterium termo*, *Sarcini ventriculi*, *Spirochœte plicatilis*, and a larger form of *Spirillum*. In addition to these I have found in the mouth in health a *Bacillus* about $\frac{1}{35000}$th of an inch in diameter, or much finer than *Bacillus subtilis*.

c. Effect of inoculation with, and of injecting bacteria solutions into, the tissues and vessels.—Koch[†] inoculated animals with decomposing vitreous humor, in which a variety of *Bacillus* had developed, which in size and appearance exactly resembled *Bacillus anthracis*, but anthrax was not produced in any case; other animals inoculated with *Bacillus subtilis* remained sound. Hiller[‡] has taken bacteria in the most different forms, and at different stages of development, that were produced in blood-serum, albumen solution, meat infusion, urine, and cultivation fluids, and separated them by filtration, diffusion, freezing, and skimming from the surface, and placed in distilled water. Their vitality was then tested by adding a drop to some of Pasteur's solution, sterilized by heat, and in all cases produced a luxuriant growth. Dogs, rabbits, and frogs were inoculated in over one hundred experiments with 0.5, 4, and even 8 cubic centimeters in one or several doses, without producing inflammation, fever, or other symptoms. The same author[§] injected bacteria cultivated in Pasteur's solution, and in some cases produced inflammation, abscess, or fever; while in others they were entirely without result. In the positive cases a much larger dose was required to produce the effect than with putrid blood or pus. Hiller thinks the experiments of Lewitzky and Andus show the toxic effect of these solutions to be independent of the bacteria; but the experiments of Chauveau[||] certainly demonstrate that the inflammatory effects of putrid pus is due to the bacteria, since when filtered the serum was inactive, but regained its properties with a new development of these organisms. Hiller[¶] did not succeed in causing suppuration in wounds of rabbits by covering them with milliards of bacteria, nor were suppurating wounds on dogs aggravated by irrigating daily with isolation solutions rich in bacteria.

I have many times injected one or two cubic centimeters of various solutions, swarming with the different bacteria forms, beneath the skin of pigs without producing any appreciable result.

We must, therefore, conclude that the ordinary septic bacteria, either in the form of micrococcus, bacillus, vibrio, or spirillum are not injurious to the health when taken with the food and drink, when inspired with the air we breath, and, in most cases at least when inoculated or injected into the tissues.

d. How bacteria injections may be rendered injurious.—If bacteria do not multiply in the tissues when introduced under ordinary circumstances, it is because the living matter of the tissues exercise an influence over them which keeps them in abeyance. Thus we have seen that so long as Hiller inoculated with pure bacteria no effect was produced, but when he injected with them the solution in which they were produced, and which also contained their decomposition products, inflammation, abscess, and fever were, at times, produced. Chauveau[**] has shown that the serum of putrid pus has toxic qualities which, though it does not produce irritating effects itself, greatly increase the effects of the solid particles when injected with them. Zuelzer and Riemschneider* found that though bacteria cultivated artificially and introduced in considerable quantity into the mouth, under the skin, and into the vessels of different animals never appeared to provoke septic accidents, the result was different when two to five centigrammes of neutral sulphate of atropin was added to the matters injected. Hence it would appear that when the vitality of the tissues is overcome by the action of a toxic agent, the bacteria find these, as well as the alimentary canal, in health, a suitable place and medium for their development and multiplication.

---

[*] Journal Roy. Microscopical Society, 1879, p. 756.

[†] Beiträge zur Biologie der Pflanzen, B. ii, H. ii, p. 298.

[‡] Lehre von der Fäulniss, pp. 176–7–8.

[§] Loc. cit., pp. 172, 173.

[||] Recueil de Médecine Vétérinaire, 1872, p. 912.

[¶] Loc. cit., p. 178.

[**] Recueil de Médecines Vétérinaire, 1872, p. 917.

If, then, the septic bacteria may multiply in parts of the body where the vitality has been impaired by such toxic matters, it becomes an important question to know if they may not also be developed in other than contagious diseases or in diseases in which their pathogenic action could not be suspected. The first step in this inquiry is to learn if the germs of these organisms find their way into the blood and tissues during health; and the question is so important, that I devote the next section to its consideration.

e. Do bacteria germs penetrate into the blood and tissues during health.— Pasteur insists that the liquids of the healthy animal body, the blood and urine for example, do not contain either bacteria or their spores; that the body is closed against the introduction of these external germs.† Koch‡ also considers the view untenable that the bacteria found in the blood and tissues of living animals sick with septicæmia are the riper forms, which develop from germs continually present, as the result of destructive changes in this fluid; for he, as well as Pasteur, Burdon-Sanderson, and Klebs, has never succeeded in finding bacteria in the blood or tissues of healthy animals or men.

In examining blood from my own finger I have frequently found a considerable number of rotating spherical and oval granules, the latter exactly resembling the spores of *Bacillus subtilis*. There may be two objections brought against these observations: 1. The granules gained entrance from the air. 2. They were not spores, but lifeless particles, perhaps of fibrin. In reply to the first, I will simply give my method of making the observation. A slide and cover glass are first well flamed, then the finger and needle used are passed several times slowly through the flame, and the puncture immediately made; the drop of blood that issues is at once touched to the cover glass, which is handled with flamed forceps, and this is inverted on the slide and immediately examined. In regard to the second objection, I do not consider any test of value except a direct cultivation experiment, made with suitable precautions, and here I can only offer the researches of others.

J. Béchamp§ coagulated the surface of pieces of horse-meat by boiling for ten minutes; he then wrapped them in closely-woven cloth, and after eight days found them in an advanced stage of decomposition, while bacteria and vibrios abounded. Dr. Lewis‖ found that when organs of chloroformed animals were separated by ligature before death and immediately removed and dipped into melted paraffin or wax, by means of the attached string, bacteria developed almost, if not quite, as soon as in the bodies of animals which had been simply set aside under like conditions. Professor Tiegel[*] made many experiments with different organs of freshly-killed animals, by dipping them, as soon as they could be removed, into paraffin heated to 110° to 150° C., and preserving with a coating of this. He found in most instances that bacteria developed in the unheated center. Dr. Burdon-Sanderson repeated these experiments, always finding bacteria.[†] Chiene and Cossar Ewart,[‡] by using, in addition, an antiseptic spray, came to a different conclusion, and thus threw doubts on all preceding experiments. Finally, Nencki and Giacosa[§] extracted slices of organs of rabbits with great care, under a spray of carbolic acid, and dipped them into a bath of molten Wood's metal (m. p. 75° C.) until the metal solidified around the fiber. In other cases they collected the organs in tubes filled with mercury, placed in bath at 120° and allowed to stand some days at 40°. The metals were previously heated sufficient to destroy all germs, and the baths were covered with a layer of carbolic acid solution. In both cases putrefaction set in after a few days.

---

* Quoted by Magnin, Les Bactéries, p. 130.

† L. Pasteur, Études sur la Bière, ses Maladies, Causes qui les provoque, procédé pour la rendre inalterable, avec une Theorie Nouvelle de la Fermentation, Paris, 1876, p. 46.

‡ Virchow's Jahresbericht über die Leistungen und Fortschritte in der Gesammten Medicine, 1878, B. I, Ab. II, p. 288.

§ Jour. Roy. Mic. Soc., 1880, p. 411, from Comptes Rendus, lxxxix, 573.

‖ Quarterly Journal Micros. Science, 1879, p. 388.

The weight of experiment is, consequently, very much in favor of the view that bacteria germs do gain entrance into the blood and tissues of healthy animals, and that they are only kept from developing by the vital influence of the bioplasm of the body. This is the view long taught by Dr. Beale.[||]

Now, if the conclusions we have reached are correct, we should expect to find bacteria developing within the body in cases where the vitality of an organ, or of the whole body, is greatly diminished by injuries or disease. Some evidence on this point will now be advanced.

f. Development of bacteria in injuries and non-contagious diseases.—Burdon-Sanderson[¶] was first to demonstrate that the exudation fluids of nearly all acute inflammations, including arthritis, pleuritis, and peritonitis, might contain large numbers of micrococci and bacteria, even when these inflammations were produced by agents with which no organisms were introduced. Billroth[**] found in fluids of an intense inflammation, produced by injection of alcohol, vast numbers of living bacteria in the rod form. Steiner and Is. Neumann[††] found them equally numerous in abscesses following the hypodermic injection of carbolic acid; Ravitsch found what he believed to be *Bacillus anthracis* which developed abundantly in a liquid collection which followed the injection of a 10 per cent. solution of sulphide of ammonium with a dog;[‡‡] and I have found vast numbers of streptococci in the peritoneal effusion of a rat that died three or four hours before examination from peritonitis caused by injuries in catching.

In 1875 Bergeron found micrococci and bacteria in the pus of six warm abscesses which had no connection with the air.[§§] The next year Billroth[||||] found micrococci and streptococci in four cases as follows: one abscess, one subcutaneous inflammation from crushing, and two pre-patellar inflammatory swellings in scrubbing women. Nepveu[¶¶]

---

[*] Lehre von der Fäulniss, p. 146, from Virchow's Archiv. B. 60, p. 453.

[†] Jour. Roy. Mic. Soc., 1880, p. 312. [‡] Jour. Roy. Mic. Soc., 1880, pp. 135, 312.

[§] Jour. Roy. Mic. Soc., 1880, p. 135, from Jour. Prakt. Chem., xx, p. 34.

[||] The Microscope in Medicine, 1878, p. 317.

[¶] Quoted by Hiller in Lehre von der Fäulniss, p. 148.

[**] Coccobacteria Septica, p. 87.

[††] Lehre von der Fäulniss, p. 148, from Ueber die Wirkung der Carbolsäure, &c., Wien, 1870.

[‡‡] Loc. cit. from Zur Lehre von der putriden Infection, Berlin, 1872, pp. 106-115.

[§§] Comptes Rendus (1875), lxxx, p. 40.

[||||] *Quoted by Hiller in Lehre von der Fäulniss, p. 147.*

[¶¶] *Quoted by Hiller, Loc. cit., p. 147.*

found micrococci in three internal cysts and an aneurism. Dr. Bastian[*] observed that there were bacteria in the fluid of a blister-bleb of a febrile patient so long as the bleb remained intact for forty-eight hours, whereas in the fluid of a blister from a healthy person no such appearances would be seen. Hiller[†] has examined a whole series of such collections of serum, due to friction of boots, crushing, application of cantharides, &c., and he finds that these lower organisms are nearly constant, and that they generally consist of mono- diplo-, and streptococci, and less often of bacteria filaments. Friedberger[‡] found, one day before death, in the pleural effusion of a horse suffering from pleuro-pneumonia, a considerable number of streptococci.

In regard to the development of bacteria in the blood, in cases where their pathogenic action could not be suspected, I have not been able to collect so many observations. Cunningham and Lewis[§] found a large number of bacteria in the blood of a dog immediately after death, from the irritating effect of liquor ammonia injected into the peritoneal cavity; and Semmer[||] found innumerable micrococci and rods in the blood only twenty-four hours after the injection of sulphate of sepsin.

Any one in a large medical library would, undoubtedly, multiply the record of such observations, but these are sufficient for my present purpose. What I wish to insist upon is that bacteria, in the various forms, frequently exist in large numbers in the blood, and are nearly constant in local inflammatory lesions, both before and immediately after death, in cases where they could have nothing whatever to do towards producing the disease. It is not my object to offer this as a proof that bacteria do not constitute the contagion of various diseases, but rather to show that the mere discovery of bacteria in a certain lesion, or in the blood, with a particular disease, is not sufficient proof of the pathogenic action of that bacteria form. Even if filaments of a particular size are always found, this is still not proof, because with the same disease the blood may undergo a certain modification that makes it more favorable to the growth of one variety. Thus, Nägeli[¶] has shown that if spores of the different varieties of fungi are allowed to fall into a neutral solution which contains sugar, bacteria alone will multiply and cause lactic acid fermentation; but if one-half per cent. of vinous acid be added to such a solution, the sprouting fungi alone grow and cause alcoholic fermentation; while if 4 or 5 per cent. of such acid be added the molds, alone, are developed. But this is not because the bacteria will not grow in the second solution or the sprouting fungi in the third, for the bacteria will develop in a solution containing one and one-half per cent. of the acid, if they are not destroyed by the other fungi.

Again, cultivation experiments are not such reliable evidence as many seem to suppose. It is true that when the eighth or tenth generation of a cultivation proves virulent, we have ample evidence that the contagium has multiplied, but does this consist of the organism to which our attention has been directed? With *bacilli*, for instance, I have never succeeded in causing all the spores to germinate at once, and in all cultivations containing rods there would at the same time be many granules supposed to be spores. But, in such a case, can one be certain that these granules are all the spores of our particular bacillus, or even that some of them are not granules of an entirely different nature? It is evident, to any one who has practically studied the question, that many granules essentially different, such as granules of bioplasm, micrococci, &c., cannot be distinguished from spores in such cultivations. Then, as I have learned in my investigations of fowl cholera, bioplasm may have exactly the same index of refraction as the liquid in which it lives, and, hence, if it happens to be without granules it is entirely invisible under the very best microscope. Finally, in nearly all of my cultivations, when examined under the $\frac{1}{16}$th-inch Tolles objective, I have seen particles so small that their presence could barely be made out, and their nature was, of course, beyond investigation; and the same observation was made by Beale when examining contagious liquids with a one-fiftieth objective. There are, consequently, several sources of error to which we are liable, even in this method of research. An example will not be out of place. Pasteur has probably made more cultivations of fungi and bacteria than any other living man; and speaking of the choice of brewer's yeast, he says: "For this choice the microscope is the best guide, but it is insufficient. One would be wonderfully mistaken if he believed in the purity of a yeast simply because it seemed to contain no foreign matters when submitted to an examination with this instrument."*

---

[*] T. R. Lewis in Quart. Jour. Mic. Sci., 1879, p. 400.

[†] Lehre von der Fäulniss, p. 149.

[‡] Quoted by Zundel in Recueil de Méd. Vét., 1874, p. 149.

[§] T. R. Lewis, in Loc. cit., p. 403.

[||] Quoted by Hiller in Loc. cit., p. 149.

[¶] Die *niederen Pilze, &c.*, p. 31.

There are still objections to the bacteria theory which it seems difficult to explain, when we consider the phenomena of many contagious diseases. Such affections do not spread with sufficient rapidity, nor leap over sufficient distances, to make it probable that they result from such organisms. Sand from the great Sahara has been carried in the atmosphere even to Rome, and South American diatoms have found their way by the same means to France; but though the spores of bacteria are much smaller, the contagium of diseases seldom leaps over a distance exceeding half a mile, and most frequently such leaps are confined to a few yards. Pleuro-pneumonia has been forty years advancing a few hundred miles in the United States; swine plague and fowl cholera may exist within the confines of a single township for a whole year and not pass beyond, and the same is true of anthrax. How different with a disease demonstrably due to even the larger spores of fungi, like the coffee-leaf disease of Ceylon! This was first seen at Madulsima in 1869, and showed itself at widely separated points, and over considerable areas the two following years. It speedily found its way to Southern India, and in 1876 appeared in Sumatra, and in 1879 in Java, Bencoolen, and Fiji.†

Again, thorough ventilation of infected apartments very often frees them of contagion in the course of a few weeks, while bacteria germs are perhaps the most indestructible of all living things, resisting alike the most intense cold and a temperature superior to boiling water. The various forms of bacteria, also, abound in all inhabitated parts of the world, but many contagious dieases, particularly of animals, are confined to certain countries and never exist elsewhere, unless by direct importation of virus; and there is now good reason to believe that the greater part of these maladies never occur, except as produced by virus originating in the body of an affected animal. But if the bacteria theory were true and especially the form advocated by Nägeli, we should expect to find spontaneous cases continually occurring.

These points are not mentioned, however, as insuperable objections—they should not discourage us in our investigation of the bacteria theory, but they should warn us against carrying this theory to extremes, in the present state of our knowledge, and convince us that such a theory is not to be accepted because of a few superficial observations. I am led to these remarks because it is quite the fashion in this country, even among scientific men, to accept every discovery of a bacterium in the blood of an animal or man, that had died of a contagious disease, as a demonstration of the pathogenic action of that organism, no matter how long a time elapsed between the death and the microscopic examination, or how few precautions were observed to prevent the admission of atmospheric germs.

---

* Études sur la Bière, &c., p. 227.

† Quart. Jour. Mic. Sci., April, 1880.

To establish this theory, an unmistakable connection must be demonstrated between the bacteria found and the contagium of the disease. If the virus is destroyed by certain extremes of temperature, the bacteria must be killed at exactly the same point; if the bacteria are destroyed by a solution containing a certain proportion of a given antiseptic, the activity of the virus must disappear under the same circumstances. Both must be overcome at precisely the same degree of putrefaction, and throughout every condition of life there must be a perfect correspondence.

Finally, when the contagium of a certain disease has been decided to be identical with a peculiar bacterium, while this makes the general theory more probable, we cannot accept it at once as a proof that other contagia consist of bacteria, since the qualities of the virus of different diseases varies to such an extent as to make it probable that they are of essentially different natures. This difference may, it is true, be owing to the different powers of distinct varieties of these organisms, but it would be exceedingly unscientific to accept this as a fact without demonstration.

II.—THE CONTAGIUM OF ANTHRAX.

As I have already stated in my report on the Southern Cattle Fever, the connection between the survival of the *Bacillus anthracis* by the production of spores and the retention of activity in the virus of anthrax so exactly correspond and may be so clearly demonstrated, that it is no longer possible to doubt the pathogenic action of this *Bacillus.*

The interest in this organism is so great and the importance of knowing the stages of development of *Bacilli* so evident, that I have reproduced drawings showing the spore formation, the appearance of the spores after the disintegration of the rods, and the germination of the spores according to Toussaint, Ewart, and Cohn. Toussaint's figures are excellent, but they appear to be magnified about twice the number of diameters indicated in the description. In the blood, during life, the organism exists in the form of rods alone, like those shown at *d* and *e*, Fig. 25, and spores are only exceptionally formed before death in local inflammatory lesions where the vitality of the tissues has been overcome. After death, however, or in suitable cultivation liquids, with a proper temperature and access of air, the filaments lengthen and form spores as in Fig. 22; the spores are afterwards freed by disintegration of the filaments, and become isolated as in Fig. 24, but they do not form zooglœa masses or present the appearance of division by fission, as is the case with micrococci. Ewart believes that the spore may divide into four sporules before germinating, as shown in Fig. 26, but his observations are so different from those of other equally competent investigators, that they require confirmation. The production of sporangial forms, Fig. 23, by cultivation in the serum of dog's blood, as observed by Toussaint, is a very interesting fact, and suggests that Hallier may not be so far from the truth, after all, in supposing that these organisms arise from the higher forms of fungi, and may develop into such again if cultivated under suitable conditions. So far all observations confirm the discoveries of Koch, that, when spore formation is prevented, the activity of the virus disappears with the death of the filaments; and that after spores have formed, the virus is not destroyed by cold, deprivation of oxygen, putrefaction, dilution, &c.; that, in other words, the condition of existence of the *Bacillus* and of the virus are identical.

During the last year a number of observations have been made which advance our knowledge very considerably in regard to this particular organism. Professor Greenfield* has shown that by cultivating the *Bacillus* in aqueous humor, its activity as a virus decreases with each generation, and that in no case were any symptoms or a fatal result produced by inoculation with a later generation than the twelfth. The cultivations were continued to the nineteenth generation, each successive generation presenting identical morphological characters at the various stages of its growth, and showing no diminution in the capacity for growth, nor marked variation in the time and temperature relations of its germination.

Colin,† while investigating the characters of malignant pustule caused by inoculating dogs with anthrax fluids, found that in many cases the pustule loses its virulence and the serum from it no longer produces the disease in rabbits. In three cases these fluids still contained the *Bacillus*, and granules having the character of its spores, but they no longer produced anthrax.

Another most interesting observation was made by Feltz‡, who found in the blood of a puerperal-fever patient, two days before death, bacteria filaments, the nature of which he investigated and found that they multiplied in the rabbit. Corresponding with Pasteur, he was convinced by this gentleman that his new leptothrix was the *Bacillus anthracis.*§

These facts would seem to indicate that Nägeli's views in regard to the pathogenic bacteria are correct; for here we have two cases in which a pathogenic form loses its virulence though it does not cease to exist, and another case in which it may be at least suspected that a septic bacterium has been transformed into a pathogenic one. At least it seems difficult to explain the presence of this parasite in puerperal fever on any other hypothesis.

Chauveau, Toussaint, Pasteur, and Greenfield have all published experiments to show that one attack preserves from a second. A mitigated form of virus is obtained by Toussaint by heating for ten minutes to 55° C., and the same result is reached by Greenfield by successive cultivations in aqueous humor.

Pasteur|| has demonstrated that the spores are carried to the surface by earth-worms, even when animals are buried at a considerable depth, and that these may produce anthrax in animals pasturing over such grounds. Only a few yards from such infected spots, however, sheep were pastured with impunity. In an outbreak of anthrax near Nancy, Tisserand and Poincaré suspected the water which moistened the pasture to be the bearer of the contagion. It was found to contain *Bacilli* similar to those in the blood of the dead animals, and when inoculated hypodermically on a guinea-pig caused death in three days; a second, inoculated with the blood of the first, died in two days of

---

* Jour. Roy. Mic. Soc., 1880, p. [illegible]9; Proc. Roy. Soc., xxx, p. 557.

† Bull. de l'Acad. de M[illegible] p. [illegible].

‡ Jour. Roy. M. S. [illegible], p. [illegible], from Comptes Rendus, 88, p. 610.

§ Jour. [illegible] p. [illegible] loc. cit., 88, p. 1211.

|| Comptes Rendus, xci, [illegible] p. [illegible].

charbon.[*] Chauveau[†] has demonstrated that Algerian sheep do not readily contract charbon; that this immunity is inherited, and that the resistance to the disease may be overcome by increasing the amount of virus used in the inoculation when the animals contract the disease.

III.—THE CONTAGIUM OF SEPTICÆMIA.

Two widely different views have long been maintained in regard to the nature of the septicæmic poison. The first is based upon the experiments of Panum, Bergmann, Zülzer, Hiller, &c., in Germany; Davaine (1864) and Robin in France, and Richardson and Cunningham and Lewis in England; by these investigations it has been shown that putrid blood, &c., may be boiled for even eleven hours without destroying its poisonous properties, that this poison may be made to combine with acids and form definite chemical compounds; that there is no period of incubation to the disease produced. These experiments are certainly definite enough to carry conviction, and to allow of clear conclusions being drawn from them; but it is equally evident that they apply only to a certain definite condition, and that their influence on the theory of contagion must be very limited. Nevertheless, these experiments have been cited, no longer ago than July, 1879, by Dr. Lewis as evidence that septicæmia is not the result of a living virus;[‡] and for this reason it has seemed best to devote a few paragraphs to the subject in this place.

In 1874, Colin[§] demonstrated that there was a wide difference in the appearance and effects of putrid and septicæmic blood. The former had a fetid odor and the globules were no longer intact; the latter presented no evidence of putrefaction, and the globules were in perfect condition; the former only acted in large dose and in an uncertain manner, failing in three-fourths, or sometimes in nine-tenths, of the cases; the latter was certain in its action even in an infinitesimal dose; the former produces, at times, septicæmia, but often a peculiar poisoning; the latter constantly causes septicæmia. The difference in the symptoms of septicæmia and the septic poisoning was very marked; the former had a period of incubation, and the effect produced was independent of the amount of virus inoculated; the latter is produced immediately after absorption of the poison, and the effect is in proportion to the quantity absorbed. Davaine[||] had shown in 1864 that the effects of putrefied substances do not go beyond the animal into which they are inoculated, and that the toxic agent of such substances cannot reproduce itself. In 1878, Koch confirmed these conclusions by his investigations with mice; he found that when these animals were inoculated with five drops of decomposing blood they die in from four to eight hours, but their blood does not communicate disease to others; but when inoculated with one-twentieth of a drop to one drop, many remain well, but others die in from forty to sixty hours, and the blood and tissue juices of these convey a disease, even when inoculated in small quantity. The former disease was sepsin poisoning; the latter was septicæmia.[¶]

In regard to the nature of the virulent agent in true septicæmia, there is still a difference of opinion. Hiller believes it to be an intese chemical poison.* Pasteur maintains that it is identical with his septic vibrio, which consists of moving filaments of various lengths, some of which may surpass the field of the microscope, but which may exist in the form of very small lenticular bodies or even as extremely short and thin rods.† Toussaint considers the disease and parasite to be identical with chicken cholera and its granules.‡ Orth, Klebs, and Birsh-Hirschfeld believe the disease to be due to micrococci, and the latter does not admit the presence of any other parasite.§ Koch found *Bacilli* one micromillimeter long ($\frac{1}{2500}$th of an inch) in the septicæmia of mice, and in the septicæmia of rabbits oval micrococci 0.8 to 1 micromillimeter in diameter.‖

---

[*] Comptes Rendus, xci (1881), p. 179. [†] Comptes Rendus, xci (1880), pp. 33, 1396, 1526.

[‡] Microphytes of the Blood, &c., Quart. Jour Mic. Sci., 1879, p. 403.

[§] Recueil de Méd. Vét., 1874, pp. 361 and 687.

[||] Comptes Rendus, lvii, 1864, pp. 230 and 386, quoted in Les Bactéries, p. 128.

[¶] Untersuchungen über die Aetiologie der Wundinfectionskrankheiten, Leipzig, 1878.

With these widely different views as to the nature of the septicæmic poison, we cannot at present come to a satisfactory conclusion; but of one thing we are assured, and that is of the extremely small size of the particles which constitute the virus. Davaine has shown that the activity of the virus increases with each generation, until with the twenty-fifth generation one-trillionth of a drop constantly produces the disease in rabbits. There must, consequently, be at least one trillion separate particles in a drop of blood, and probably many more, or they could not be so thoroughly distributed in the dilution of this as to have each drop of the resulting mixture become virulent. But if we take this number for our consideration, we find it so large as to make it seem impossible that the micrococci of Koch can be the cause of the disease, unless they exist also in a form very much more minute, for an average drop would not exceed fifty cubic millimeters in capacity, or fifty billion cubic micromillimeters, and two of the micrococci would equal one cubic micromillimeter; hence, a drop could only contain one hundred billion of these micrococci if packed solidly with them, which is far from being the case even when we include the blood corpuscles. But this number is ten times too small, and if we consider that there should be *more* than one trillion particles, and that the blood drops only contain a small part of their capacity of micrococci, it seems impossible to accept these as the only cause of the disease.¶

IV.—THE CONTAGIUM OF FOWL CHOLERA.

Toussaint and Pasteur succeeded in cultivating the granules of this disease. The latter found it to develop with extraordinary rapidity in an infusion of chicken muscle, neutralized with potash and sterilized by a heat of 110° to 115° C. Although the most diverse micro-organisms, including the *Bacillus anthracis*, grow readily in yeast water (*i. e.*, decoction of beer yeast, filtered and sterilized by heat), the microbe of chicken cholera not only does not multiply in it but perishes in less than forty-eight hours.** This suggests that there is a wide difference between the granules of fowl cholera and any form of bacteria, and it indirectly confirms the view that the contagia of different diseases may be of widely different origin and nature. I have cultivated the granules up to this time in infusion of chicken muscle alone, and I find that they form an exceedingly delicate membrane (petalococcus of Billroth) on the surface of the liquid after the manner of bacteria, and that this membrane is made up of the granules having the same appearance as in the blood.

---

* Lehre von der Fäulniss, p. 167.

† La Theorie des Germes, Recueil de Méd. Vét., 1878, p. 513.

‡ Comptes Rendus, xci (1880), 301 to 303.

§ Referred to by Méguin in Les Bactéries, p. 133.

‖ Jour. Roy. Mic. Soc. 1879, p. 755.

¶ This calculation is modified from one by Hiller in Lehre v. d. Fäulniss, 167.

** Bul. de l'Acad. de Méd., 1880, pp. 121 to 134.

My observations that the blood in this disease contains few if any free granules immediately after being drawn from the vein during life, and that these apparently wander from the nuclei and leucocytes in the same manner as the former wander from the red corpuscles, is still further evidence that they may be granules of animal protoplasm instead of being of a vegetable nature.

Toussaint* says: "Two animals of the same species inoculated with blood from chicken cholera and acute septicæmia present the same symptoms, die in the same time, and have exactly the same lesions. The parasite in each case is the same." He has produced exactly the lesions of cholera by feeding blood, &c., of septicæmic animals.

On the other hand, Pasteur, who has studied both diseases for a long time, says: "I am not in accord with M. Toussaint in regard to the identity which he affirms to exist between acute septicæmia and the cholera of fowls. These two diseases are entirely different."†

The virus, according to Toussaint, kills rabbits in twelve to fifteen hours, and injected under the skin of the horse, ass, dog, and sheep causes formation of a tumor, which is resolved into an abscess with very grave general symptoms, but without the blood becoming virulent.

Pasteur finds that guinea pigs are not killed by such inoculations as certainly as fowls, but that the formation of an abscess is often the only result. This would seem to oppose the idea of its being identical with septicæmia, since guinea pigs are extremely sensitive to this virus.

The same gentleman has succeeded in obtaining a mitigated form of the virus by allowing his cultivations of the granules in infusion of chicken muscle to stand three to eight months in contact with atmospheric oxygen. In successive cultivations made within a few days of each other there was no dimunition of the virulence after an indefinite number of generations; but when a cultivation was allowed to stand several months before another generation was started, the virulence was found to be remarkably diminished, and this diminution might be carried to any point desired, up to the death of the granules. Now, if this attenuated virus is cultivated with short intervals between the generations, it is found to remain in its mitigated condition; and if the intervals between the generations are increased, it perishes at a point which a more active virus would survive. Finally, Pasteur has proved that this attenuation is caused by exposure to the oxygen of the atmosphere, for if the cultivations are made in sealed tubes nearly filled with the cultivation liquid, the oxygen is exhausted by the growth of the microbe, and, being no longer subjected to its influence, the virulence is retained an indefinite time in its original condition.‡

All observations, then, point to these granules as the active agents of the disease, but as to their exact nature and origin there is still reason for doubt.

V.—THE CONTAGIUM OF SWINE PLAGUE.

In regard to the parasite of swine plague, or, more correctly speaking, the form of organism found in the virus, there is far from being the same unanimity of opinion. Dr. Klein§ and Dr. Detmers|| believe it to be

---

*Comptes Rendus, xci (1880), p. 301.

†Comptes Rendus, xci (1880), p. 457.

‡Comptes Rendus xci (1880), pp. 673 to 680.

§Quart. Jour. Mic. Sci., April, 1878.

||Report of Department of Agriculture, 1878, also, contagious diseases of swine and other animals. Department of Agriculture, 1880.

a *Bacillus*, while Méguin* and myself† have found granules which form clusters and chains but not rods. Klein found in the virus granules which he at first took for micrococci, and only after a number of cultivations succeeded in obtaining what he believed to be a pure crop of *Bacilli;* inoculations with this cultivated virus are said to have produced the disease, but unfortunately the number of animals inoculated or the symptons or *post-mortem* appearances of the affected ones have not been made public. The *Bacilli* are described as growing to long rods, with a swarming stage, rapid multiplication by division, growth into long apparently smooth filaments, and, with sufficient access of air, the formation of bright cylindrical spores.

Now, in view of the other investigations noted, it would be interesting to know if the granules observed in the virus were cylindrical, and if in the cultivations the whole or any considerable part of these existed at any one time in the condition of filaments. Méguin and the writer have found only spherical granules in the virus, and Detmers speaks of the granules as globular and figures them by small circles; hence the pertinent question, were the original granules observed by Klein spherical or cylindrical? Figs. 20 and 21 show the granules observed by Méguin in the blood and bronchial mucus, and it is evident the organism there figured is identical with the one observed by me.

Again, Dr Klein could not have found *Bacilli* filaments in the virus, or he would not have considered the organism at first as a micrococcus; Dr. Detmers maintains that the rods exist in the blood and tissues even during life; while blood which I obtained by breaking capillary tubes within the blood-vessels and immediately sealing, and which consequently was not exposed to the air at all, developed chains of spherical granules alone and never *Bacilli.* Even when such virus was cultivated on slides with access of air in aqueous humor, white of egg and urine, I have only obtained the granules singly in clusters and chains. Dr. Detmers has not, as I understand, taken any precautions to prevent access of atmospheric germs, and in most cases his observations seem to have been made some hours after death; hence, it is at least possible that the *Bacilli* filaments found in the blood and exudation liquids developed from septic germs admitted from the air, or even from such germs contained in these liquids before death.

Dr. Klein states that his *Bacillus* had the same stages of growth as the *Bacillus subtilis*, and consequently as the *Bacillus anthracis*, and like it requires the admission of oxygen to enable it to form spores. Now, the *Bacillus anthracis* only exists in the blood as filaments during the life of the animal, and only forms spores after the death of the host. It is the filaments, not the spores, that develop in the blood, block up the capillaries, and by their vital activity cause the formation of poisonous matters, which completes their pathogenic influence. It is difficult to see how such comparatively dormant bodies as spores can have any influence on the health of animals, or even how they can reproduce themselves in the fluids of the body if these do not contain filaments as well.

We are, consequently, forced back upon the observations of Dr. Detmers, who has found filaments as well as granules; but these granules, at least, do not correspond with those of Dr. Klein, since they are globular instead of cylindrical, form zoogloea masses, and multiply by fission; nor do the filaments of Detmers form cylindrical spores. It would seem, therefore, that the observations of this gentleman do not confirm those of Klein any more than they do those of Méguin and myself. In each case there is an important discrepancy.

---

* Recueil de Méd. Vét., 1880, pp. 36 and 37.

† Part I of this report.

There are only four suppositions which I can admit in explanation of this variation of observation, considering that in each of three outbreaks in different sections studied by me I constantly found the same organism: 1. The diseases studied by Klein, Detmers, and myself may not have been identical. 2. The same organism may assume different forms under different conditions. 3. The filaments of Klein and Detmers may have developed from septic spores different in nature, but resembling the pathogenic granules. 4. The virus may consist of transparent bioplasm or of granules so small as to have escaped the attention of all observers. The first supposition is doubtful because of the similarity of symptoms and lesions; the second and fourth are more probable but still doubtful; the third I must at present regard as most probable, for reasons to be given immediately.

In the outbreaks of swine plague studied by me in 1878, there were frequently found gangrenous patches of the skin and intestines, and the animals had a plain odor of putrefaction even before death; and this could only occur from one cause, viz., the multiplication of the septic bacteria in the gangrenous parts, probably in the exudation liquids as well, and possibly also in the blood. At any rate, within an hour or two after death, these animals had such an extremely offensive odor as to make it nearly certain that a microscopic examination would have revealed not only micrococci but *Bacilli* and *Vibrios;* at least, I have almost always found these different organisms in liquids studied by me during the last year, which had reached a similar state of decomposition.

In the disease as studied by me during the present year, however, these phenomena were not present; the attacks were mild; there were no gangrenous patches and no offensive odor; several of the animals would have recovered, and there was no reason to believe that any multiplication of septic bacteria had occurred. The blood of these was gathered at slaughter, sealed in glass tubes without coming in contact with the air, and those germs which existed in the blood, and no others, had an opportunity to develop.

Finally, I have made microscopic sections of the lung, ulcerated intestine, and papules of skin. In some cases the tissues were fresh and cut by means of the freezing microtome; at other times they were preserved in glycerine, chromic-acid solution, or alcohol; the sections have been examined in the natural condition, and also stained with carmine, hæmatoxylon, or aniline violet. I have particularly used the method recommended by Eberth*, by which he demonstrated *Bacilli* in the liver of a badger. It consists in placing thin sections in a tolerably strong solution of methyl violet for one to six hours, then washing in water containing one-half per cent. of strong acetic acid, in which they remained from one to four hours, until no more coloring matter was dissolved out. The sections are then placed in alcohol, which removes still more of the coloring matter, and they are then either mounted in glycerine or clarified with oil of cloves and mounted in balsam. By this treatment the tissues remain nearly colorless, while the nuclei and bacteria, if any exist, retain the coloring matter. In none of these sections have I been able to demonstrate the presence of *Bacilli*.

Virus sent me by Dr. Detmers in a liquid form still contained many such *Bacilli* as he has described, and also a considerable number of both oval and spherical particles, which I considered as bacteria spores. But inoculation proved that this liquid was no longer a virus, that it had lost its activity by putrefaction, though the septic rods supposed to be peculiar to the virus were still retained, and by their active movements demonstrated their vitality. Again, cotton saturated with pleural effusion and dried by the same gentleman was placed in a clean beaker and moistened with distilled water; in less than an hour this water swarmed with *Bacilli* of the same dimensions, viz., about one thirty-five thousandth of an inch in diameter, and from one eight thousandth of an inch to several times this in length. There were also oval bacteria spores and globular bacteria in both clusters (zooglœa) and chains, as well as singly. In this case there was no odor of putrefaction. Still, three cubic centimeters, injected hypodermically, did not in the least affect the health of the animal.

---

* Journal of Roy. Mic. Soc., 1880, p. 133.

The only conclusion I care to draw from these experiments is that the *Bacilli* and globular micrococci described as peculiar to swine plague exist as well in decomposing liquids, and may be injected in vast number without producing the disease. Indeed, rods of the dimensions given are frequently found in the human mouth.

There is one other objection to the view that the granules of the blood in this disease are *Bacillus* germs or spores. All observers agree that such spores are indestructible by prolonged drying, putrefaction, or other natural agencies; the spores of *Bacillus anthracis* resist such conditions for years; but putrefaction destroys the virus of swine plague in a few days, and virus dried before such granules could have possibly germinated to rods may lose its activity as soon, and generally does in a few months.

In his last report, Dr. Detmers[*] thinks he may have misnamed his bacterium in calling it the *Bacillus suis*, because (1) in the germ or globular form it developes in zooglœa clusters, and because (2) it undergoes a change from the globular to the rod shape—characteristics not recognized in regard to the genus *Bacillus*. I see no reason to doubt, however, that the rods are *Bacilli*, for the characteristics of this genus, as given by Cohn,[†] in 1875, and very recently by Luerssen,[‡] do not include the method of reproduction. It is not admitted by Cohn that bacteria rods of any kind (except *Bacterium termo*, which can scarcely be considered as rods) form zooglœa masses, though Ray Lankester and Klein believe they have observed such forms with certain varieties of *Spirillum*,[§] and Prazmowski has observed the same with *Bacillus amylobacter*.[‖] What is more to the point, it is not admitted by the best authorities that *Bacilli* have any other vegetation forms than spore, rod, and filament. The spores of this genus have never been observed to multiply by fission and form zooglœa clusters, but always to germinate into rods either immediately, as maintained by Cohn, Koch, and Toussaint, or after division into four sporules, as believed by Ewart.

The fact, then, that Dr. Detmers's globules multiply by fission and form gliacoccus clusters, as was the case with those I observed, is not evidence to me that the organism seen by him is entirely different from any other bacteria form yet discovered, but it seems more reasonable to believe that the globules and rods are distinct organisms, and that the particular granule which he saw develop into a rod was different from those granules which form gliacocci. To watch the germination and development of a spore into a rod is a more delicate and difficult matter than is generally supposed. Some of our best microscopists have spent hours and days watching such germs without being able to satisfy themselves that they germinate;[*] and it would not be very remarkable if a mistake had been made in such an observation.

---

[*] The Contagious Diseases of Swine and Other Animals, Department of Agriculture, 1880, p. 60.

[†] Beiträge zur Biologie der Pflanzen, B. I. H. III, p. 203.

[‡] Quoted in Journal Roy. Mic. Soc., 1880, p. 837.

[§] Mégnin, Les Bactéries, p. 33.

[‖] Journal Roy. Mic. Soc., 1879, p. 927.

If we add to this reasoning the fact that in a very considerable number of cultivations, made with great care, I was never able to obtain rods from the granules which I found in the virus, it seems to me the probabilities are entirely against the view that they are *Bacillus* germs, or that they develop into a rod form.

These are the results of my investigations of the virus of swine plague. I had hoped by cultivation experiments to prove that the granules observed either were the cause of the disease or that they are an epiphenomenon; but owing to the fact that the virus in every case lost its activity after the first generation, or became too mild to afford satisfactory results, such evidence could not be obtained. It was impossible for me to carry the virus beyond a second generation, even by inoculating on pigs that had never before been exposed to the contagium.

If, in conclusion, we admit the presence of a particular bacteria form in the effusions, or even in the blood, in this disease, the facts already referred to in regard to the presence of such organisms in non-contagious maladies, often before death, renders it necessary that a connection be established between such bacteria and the contagium; and certainly no satisfactory connection or identity has been shown to exist between the bacteria and virus in this disease up to the present time.

PART IV.—INFLUENCE OF RECENT INVESTIGATIONS ON OUR MEANS OF PREVENTING CONTAGIOUS DISEASES.

Medical treatment.—Although Davaine[†] has recently proved that a solution of iodine containing but one seventy thousanth part of this substance was sufficiently strong to destroy the virus of anthrax, it has not succeeded so well in the treatment of the affection as this fact had led us to expect. There has, consequently, been little real advance in the medical treatment of this class of diseases.

Vaccination.—At present the attention of investigators is still turned for the most part to methods of prevention, and chief among these is inoculation by means of a mitigated virus. This has been obtained in the case of anthrax by two methods; that of Toussaint, which consists in heating the virus to a temperature of 55° C. for ten minutes, and that of Greenfield, by successive cultivations in aqueous humor.

Pasteur has obtained a similar form of virus for fowl cholera by allowing cultivations of the ordinary virus to remain in contact with the air for a number of months before starting a new generation.

The advisability of using such a virus can only be determined by an extended series of experiments, for objections of considerable weight might develop themselves in practice. The fact that the disease is communicated by the digestive tract would favor the process of inoculation, for it would only be necessary to mix the virus with the food, and thus inoculate by wholesale.

---

[*] Dr. T. R. Lewis, Quart. Jour. Mic. Sci., 1879, p. 389.

[†] Bul. Acad. de Méd., 1880, p. 757.

Breeding from insusceptible animals.—Chauveau* has shown that the insusceptibility of Algerian sheep to charbon is an inherited power, and he proposes to confer this upon other breeds by crossing. Of course, the practicability of this is yet to be tested, but the idea is one worthy of careful consideration. But if insusceptibility to charbon is inherited by a certain breed of sheep, may not fowls insusceptible to cholera be capable of conferring the same power of resistance upon their offspring? I have found that a very considerable proportion of fowls are capable of resisting repeated inoculations with very active virus, some showing only the mildest symptoms of the disease, and others remaining entirely free from any appreciable results, either in general health or at the point of inoculation. It would be a matter of the very greatest importance to breed from such birds, and then determine the proportion insusceptible among their progeny. It is possible that this might prove the most practicable method of dealing with this destructive epizoötic.

Prevention of fowl cholera.—This disease can only be introduced on a place by direct importation of the virus, either with fowls, or by birds, rabbits, or insects carrying it from neighboring farms. An outbreak is generally caused by fowls from infected premises being added to the flock. The virus is never carried through the atmosphere.

When more than one fowl dies within a short time, cholera should be suspected, and a careful investigation of the case made. If the urates of the excrement are stained yellow or yellowish green, especially if there is diarrhea with excrement of this color; if the liver is enlarged, and the birds sleep most of the time before death, no time should be lost in adopting measures to check the disease.

For this purpose, the fowls should be separated as much as possible, and given restricted quarters where they may be observed, and where disinfectants can be freely used. As soon as the peculiar diarrhea is noticed with any of the fowls, the birds of that lot should be changed to fresh ground, and the sick ones killed. The infected excrement should be carefully scraped up and burned, and the inclosure in which it has been thoroughly disinfected with a one-half per cent. solution of sulphuric acid, or a one per cent. solution of carbolic acid, which may be applied with an ordinary watering-pot.

Dead birds should be burned, or deeply buried at a distance from the grounds frequented by the fowls.

The germs of the disease are taken into the system only by the mouth, and for this reason the watering troughs and feeding places must be kept thoroughly free from them by frequent disinfection with one of the solutions mentioned.

Sulphuric acid is very much the cheaper disinfectant, and is equally efficient with carbolic acid, even in solutions of half the strength; indeed, so far as expense is concerned, it would seem impossible to find a disinfectant that will compare with the sulphuric acid solution.† The one objection to recommending the indiscriminate use of sulphuric acid as a disinfectant is its great corrosive powers when in the concentrated form, which makes it unsafe for those not acquainted with its nature to handle it. The same is true to a less extent of carbolic acid, however, and it is possible that dealers could furnish a sufficiently diluted solution of the former to be handled with safety, and still at a price very much below other disinfectants, or that plain directions for use accompanying each package would render even the commercial acid safe in the hands of the great majority of people.

---

* Comptes Rendus, xci (1880), p. 33.

† *This solution* was first recommended by M. Pasteur.

Three weeks after the last case of sickness, the fowls may be again placed together in a disinfected run, or in one where the sick birds had not been admitted. They should be kept here under observation for at least two or three months before being allowed to roam over grounds that had been infected by the discharges of those affected with the disease.

If the disease breaks out afresh, it is evidence that the disinfection has not been thorough, or that the fowls have gained access to infected places that have not been treated with the solutions. My experiments demonstrate beyond a doubt that either of the solutions mentioned destroys the virus of the disease in a few minutes; and as there is no reason to believe that the disease ever originates except from the introduction of virus produced in the body of a previously sick bird, we have here a reliable means of freeing any farm or any section of the country from the ravages of this fatal plague.

The one doubt that still remains is in regard to the time that the virus may exist in open grounds where disinfection is difficult if not impossible, owing to the extent of surface to be gone over. Whether such grounds are safe after a few months, or whether this time must be extended to a year or more, it is impossible at present to say. Until this point is decided by direct experiment, however, the only safe plan is to keep the fowls in a restricted run, which has been previously well disinfected, and not to allow them on infected grounds for a year or more after the infection has occurred.

As the disinfecting solution may be made by adding one pound of sulphuric acid to twenty-four gallons of water, or one ounce of acid to six quarts of water, and as the acid costs but 15 to 20 cents per pound at retail and only 3 to 6 cents at wholesale, the expense of disinfecting a very considerable space would be slight.

Medical treatment.—Treatment of sick birds is not to be recommended under any circumstances. The malady runs its course, as a rule, in one, two, or three days, and it can only be checked with great difficulty. As the appetite is very poor, medicine can only be administered regularly by taking each bird by itself and forcing it to swallow. But this requires too much time to make it advisable, if there were no other objection to the practice. Even in those cases in which I have succeeded in prolonging the life for two to three weeks death has finally occurred from profound changes in the liver and intestines. The great reason, however, for not treating sick birds is that the excrement is probably filled with the contagion, and it is much better to destroy them at the start than to keep them to multiply the contagious germs and infect the grounds and remaining fowls.

The only preventive treatment needed is the disinfection and isolation already described at length.

Respectfully submitted.

D. E. SALMON, D. V. M.

ASHEVILLE, N. C., *December* 1, 1880.

APPENDIX TO DR. SALMON'S REPORT.

RECORD OF EXPERIMENTS NOT DETAILED IN BODY OF REPORT.

Experiments to determine the effect of solutions of chloride of zinc on the virus of swine plague. Inoculations, January 3, 1880.

PIG No. 1.—*Inoculated with pure virus.*

Date.		Hour.	Atmospheric temperature.	Body temperature.	Remarks.
1880.		A. M.	° F.	° F.	
Jan.	5	8.30	43	102⅗	
	6	9.00	60	102⅘	
	7	10.00	58	103⅕	Two small pieces of dried inflamed lung, introduced hypodermically.
	8	8.00	53	103	Coughs.
	9	9.00	50	103	
	10	8.30	52	102⅘	
	12	8.15	60	102	Has eruption.
	13	9.30	34	101⅗	Eruption much plainer.
	14	8.30	28	100⅗	
	15	9.15	32	101	
	16	9.00	32	102	
	17	10.30	....	102⅖	Coughs very much.
	20	....	....	101⅗	

This animal was kept till January 31, and was then killed by bleeding. It had improved slightly during the last few days.

Post-mortem examination.—Skin: The eruption still very plain, and consists of papules flat on summit and one-third inch in diameter and less.

Areolar tissue: Has several deposits of dark pigment.

Digestive organs: No lesions except adhesions of large intestines by inflammatory new formations. *Parasites:* In large intestine, considerable number of *Tricocephalus crenatus;* in small intestine, very many of the *Echinorhynchus gigas* from 12 to 18 inches in length.

Kidneys: These organs were normal, but the tissues about them were thickened, hardened, and completely filled with the worm known as *Stephanurus dentatus.*

Lungs: In color nearly normal, but large portions did not collapse and give a hard, solid sensation to the touch. Bronchi filled with white froth, with considerable thick tenacious mucus; following the ramifications of these, a small number of the *Strongylus elongatus* or lung worm were found; some were even in the smallest tubes that could be traced.

Microscopic examination of contents of bronchi: This was found to consist of large granular leucocytes, with a few small ones, a considerable amount of *débris* from the mucous membrane lining these passages; some bodies resembling the torula form of fungi, and vast numbers of small spherical granules, *i. e.*, micrococci.

This pig had been affected with the most troublesome cough of any in this series of experiments; the eruption had also been among the plainest, and it was a surprise to find so few of the ordinary lesions of swine plague.

PIG NO. 2.—*Inoculated with pure virus diluted with four parts distilled water, January 3, 1880.*

Date.	Hour.	Atmospheric temperature.	Body temperature.	Remarks.
1880.	*A. M.*	°*F.*	°*F.*	
Jan. 5	8.30	43	102¼	
6	9	60	103	
7	10	58	104	
8	8	53	102⅘	
9	9	50	104⅗	
10	8.30	52	103⅖	
12	8.15	60	102⅘	
13	9.30	34	103½	
14	8.30	28	103	
15	9.15	32	102½	Has eruption.
16	9	32	102⅕	
17	10.30	....	102	
20	....	....	102⅕	

But for the eruption, which was very plain, it would have been impossible to have detected the disease in this animal. She was preserved and afterwards used in other experiments.

PIG No. 3.—*Inoculated with virus that had been mixed one-half hour before using with four parts of solution of chloride of zinc 1 to 500.*

Date.	Hour.	Atmospheric temperature.	Body temperature.	Remarks.
1880.	*A. M.*	°*F.*	°*F.*	
Jan. 5	8.30	43	102¼	Inoculated January 8.
6	9	60	102	
7	10	58	103⅘	
8	8	53	103⅘	
9	9	50	104⅘	
10	8.30	52	103⅕	
12	8.15	60	102⅘	
13	9.30	34	102⅘	
14	8.30	28	101⅕	
15	9.15	32	100⅘	Has eruption.
16	9	32	102⅕	
17	10.30	....	102	Coughs.
20	....	....	100⅕	

The disease was so mild that the animal was preserved for future experiments.

PIG No. 4.—*Inoculated with virus that had been mixed one-half hour before using with four parts of solution of chloride of zinc 1 to 1000.*

Date.	Hour.	Atmospheric temperature.	Body temperature.	Remarks.
1880.	*A. M.*	°*F.*	°*F.*	
Jan. 5	8.30	43	103⅘	Inoculated January 3.
6	9	60	104¼	
7	10	58	105	
8	8	53	103⅕	
9	9	50	104⅗	
10	8.30	52	104⅗	
12	8.15	60	104⅘	Coughing.
13	9.30	34	103⅗	
14	8.30	28	103⅕	
15	9.15	32	104⅕	Has eruption. Vast increase of leucocytes and granules in blood.
16	9	32	103⅘	
17	10.30	....	103⅘	Covered with eruption.

Killed by bleeding at 2 p. m., January 17.

This animal had never appeared quite well; she did not thrive, and was dull and languid. Her appetite was always good, but she had a chronic affection of the skin, and had lost flesh rapidly for the few last days. Although inoculated with virus, treated with chloride of zinc solution of 1 : 1000, which made a cloudy mixture by coagulation as soon as the contagious effusion touched it, she was one of the first to present symptoms of the disease (cough and eruption).

Post-mortem examination.—Skin: Covered with papules, particularly plain on inside of thighs, over the belly, and between the fore-legs.

Areolar tissue: A number of deposits, an inch or more in diameter, of a dark bluish pigment, were found in the subcutaneous tissue; it was most abundant about the mammary glands.

Digestive organs: Were closely united, and the mesentery much thickened, as the result of inflammation. The newly-formed tissue about the intestines contained considerable numbers of the *Stephanurus dentatus*, or lard worm. The large intestine showed no trace of thickening, ulceration, nor even of congestion; the small intestines were blocked completely, as it seemed, with large numbers of the *Ascaris suilla*, from ten inches to one foot in length; there were also many of the *Echinorhynchus gigas* a foot or more long. The duodenum was the seat of a few elevations one-eighth inch in diameter, and having a red, inflamed appearance. The mucous membrane of the stomach had a patch two or three inches in diameter, corresponding to the greater curvature, of a deep red hue, and evidently the result of congestion.

Liver: Somewhat congested and softened.

Spleen: Had a deep red border, and was mottled over its surface.

Lungs: The greater part of the tissue hepatized, and many of the bronchial tubes entirely blocked with lung worms (*Strongylus elongatus*). Bronchi filled with white froth.

Hyperæmia of nearly all the *lymphatic glands*.

PIG No. 5.—*Inoculated with virus mixed one-half hour before using with four parts of a solution of chloride of zinc 1 to 4000.*

Date.	Hour.	Atmospheric temperature.	Body temperature.	Remarks.
1880.	*A. M.*	° *F.*	° *F.*	
Jan. 5	8.30	43	100½	Inoculated January 3.
6	9	60	100½	
7	10	58	102¼	
8	8	53	102⅓	
9	9	50	102¼	
10	8.30	52	102	
12	8.15	60	102	
13	9.30	34	99	
14	8.30	28	97½	
15	9.15	32	96¾	Scarcely perceptible; discoloration of skin.
16	9	32	97	
17	10.30	....	97	
20	....	....	100½	Redness of skin more marked; slight eruption.

No other symptom of disease observed. Animal preserved.

PIG No. 6.—*Inoculated with virus mixed one-half hour before using with four parts of a solution of chloride of zinc 1 to 3000.*

Date.	Hour.	Atmospheric temperature.	Body temperature.	Remarks.
1880.	*A. M.*	° *F.*	° *F.*	
Jan. 5	8.30	43	102⅕	Inoculated January 3.
6	9	60	103⅖	
7	10	58	103⅘	
8	8	53	103⅗	
9	9	50	104	
10	8.30	52	103⅘	
12	8.15	60	103	
13	9.30	34	103	
14	8.30	28	102	
15	9.15	32	100⅕	Slight redness of skin.
16	9	32	100⅖	Dull purple patches on skin.
17	10.30	....	100⅘	
20	....	....	99⅘	

No additional development of disease. Animal preserved.

PIG No. 7.—*Inoculated with virus treated with four parts of a solution of chloride of zinc 1 to 5000, one-half hour before using.*

Date.	Hour.	Atmospheric temperature.	Body temperature.	Remarks.
1880.	*A. M.*	° *F.*	° *F.*	
Jan. 5	8.30	43	101⅕	Inoculated January 3.
6	9	60	101⅖	
7	10	58	103⅖	
8	8	53	103⅗	
9	9	50	100	
10	8.30	52	100⅕	
12	8.15	60	99	
13	9.30	34	98⅗	
14	8.30	28	99⅗	
15	9.15	32	98⅘	Very thirsty; covered with eruption.
16	9	32	97⅘	Increase of eruption.
17	10.30	....	100	Dull.
20	....	....	101⅗	Very red on inner side of thighs and on abdomen; ears lopped; dullness marked.

Killed by bleeding, January 23.

A peculiarity of this, as well as of the other animals of this series, was that none had the appearance, to the casual observer, of being sick. All had good appetites; indeed, would squeal lustily at feeding time till they received their share. The emaciated appearance, the arched back, the tucked-up abdomen, the staggering gait, the tendency to hide in the litter and keep quiet, the continued elevated temperature which are generally observed, were nearly or entirely absent. This animal had a very profuse eruption, a few petechial spots, the ears were slightly lopped, and from a very fierce, aggressive animal, she became more gentle and tractable. These were the only external signs of the disease.

Post-mortem examination.—Abdominal organs: On incising the walls of the abdomen a considerable number of spots of extravasated blood were noticed in the areolar tissue; there were two or three ounces of clear effusion in the abdominal cavity; patches of congestion in both large and small intestines; enlarged and hyperæmic lymphatic glands; slight congestion of kidneys and liver, but less than usual of the inflammatory; new formation uniting the intestines. The *Stephanurus dentatus* abounded about the kidneys and had caused the formation of a false membrane on their surface; there were, also, many of the *Echinorynchus gigas* in the small intestines.

Thoracic organs: On opening the thorax there could no longer be doubt of the presence of the disease. Nearly the entire tissue of both lungs was of a deep red color and hepatized. The right lung was adherent to the thoracic wall, about midway between spine and sternum, by a delicate, transparent, though very resisting false membrane. Greatly distended blood-vessels were to be traced on the surface of the lung.

On following the bronchi nearly to their termination, a few very small, evidently young, worms (*Strongylus elongatus*) were found.

INVESTIGATIONS OF BACTERIA, PARTICULARLY OF THE MICROCOCCUS FOUND IN SWINE PLAGUE VIRUS, AND THE EFFECT OF DISINFECTANTS UPON THEM.

EXPERIMENT NO. 1.—*Forms arising spontaneously in urine.*—In each of six test tubes was placed 20 cubic centimeters of fresh urine; the tubes were then closed by tying a piece of sheet caoutchouc tightly over the top. They were then heated to 87.8° C. (190° F.) for fifteen minutes—the highest point that could be reached without danger of explosion. The covers of Nos. 1, 2, and 3 were then removed for one minute and again replaced as before; all were now placed in an incubator at 90° F. for five days. A seventh tube, containing the same liquid, was allowed to stand loosely corked in the laboratory for comparison.

Results of examination, March 24, 1880.

All examinations made with a Tolles one-fifteenth objective.

Tube No. 1: Liquid clear; neither membrane nor deposit. Contained moving bacilli answering the description of *Bacillus subtilas*; elliptical granules, which I shall hereafter speak of as *bacillus* spores—having traced their origin so often as to dispel all doubts; and a considerable number of small aggregations of spherical granules, but no chains of these—the individual granules were $\frac{1}{30000}$th of an inch, or somewhat less, in diameter.

Tube No. 2: Membrane on surface; liquid clear; no deposit. Contains vast numbers of the *bacillus* spores and a few of the rods.

Tube No. 3: Liquid clear; no membrane; slight flocculent deposit. Contains bacilli and spores as in Nos. 1 and 2; also, rods $\frac{1}{5000}$th to $\frac{1}{6000}$th of an inch in length, and $\frac{1}{35000}$th of an inch in diameter, with an elliptical granule at one end, the long diameter of which was apparently at right angles to the rod (helobacteria).

Tube No. 4: No membrane on surface; liquid clear; slight flocculent deposit. Contains *bacilli* and spores; also, many motionless spherical granules, just visible, having the appearance of *débris* rather than of living bacteria.

Tube No. 5: Grayish-brown membrane on surface; liquid clear; no deposit. *Bacilli* of two distinct sizes, one being of the diameter of *B. subtilis* ($\frac{1}{25000}$th inch), the other much finer ($\frac{1}{40000}$th inch), both existing as short moving rods and as matted masses of filaments, some of which were forming spores; many free spores of the former; a single aggregation of spherical granules, having the characters of the swine plague micrococci.

Tube No. 6: Grayish-brown membrane on surface; liquid clear; no deposit. Many *bacilli* as rods and filaments, some containing spores and immense number of free spores.

Tube No. 7: Surface covered with a membrane; liquid turbid; slight deposit. Myriads of flexible rods in movement having the characters of Pasteur's *butyric vibrio*. A few isolated spherical granules and one small aggregation.

From this experiment we may conclude that there exists in the air the spores of *bacilli* of different varieties, the diameter of some not being over $\frac{1}{40000}$th of an inch, and that some of these multiply by forming elliptical spores; also, that helobacteria and spherical micrococci may be found under similar conditions. A temperature of 190° F. for fifteen minutes is plainly insufficient to destroy the germs of these organisms.

EXPERIMENT NO. 2.—*Effects of inoculating urine in tubes with micrococci of swine plague.*—Six test tubes were prepared as in experiment No. 1, and after being heated to the same degree for the same time, the covers were removed and four drops of an infusion of beef, in which the swine plague micrococci had been cultivated, were added to the contents of each tube. The infusion was swarming with clusters of this organism.

Results of examination after ten days.

Tube No. 8: No membrane on surface; liquid turbid; slight deposit. Contains nothing but spherical granules existing in vast numbers, singly, in couples, and clusters.

Tube No. 9: No membrane; liquid turbid; slight deposit. Contains immense numbers of micrococci as in the preceding and a few bacillus rods.

Tube No. 10: No membrane; liquid turbid; slight deposit. Swarms with the micrococci, single, in couples, chains, and clusters.

Tube No. 11: Liquid covered with a membrane; turbid with a flocculent deposit. A few micrococci and *bacilli* have gained possession of the liquid, and it swarms with the rods and elliptical spores.

Tube No 12: Membrane; liquid clear; no deposit. Contain so many bacillus rods that the few micrococci could only be found with difficulty.

Tube No. 13: Membrane; liquid clear; no deposit. Swarms with *bacilli* and spores.

It was concluded from this experiment that by adding the micrococci in considerable quantity to the cultivation liquid, and by closing the tube so that but a few spores could gain entrance from the air, a nearly pure growth of these could be obtained in a sufficient number of cases to admit of the following experiments being made.

It is also to be noticed that the liquids presented a different appearance to the naked eye, according as they were the growth of the micrococci or the bacilli. The former organism commenced its multiplication at the bottom of the tube, and the turbidity caused by its increase gradually extended towards the surface, while a whitish deposit, composed of the clusters, accumulated at the bottom. It is only after longer periods that I have noticed a delicate membrane form on the surface of what I believe to be pure cultivations of this organism. The *bacilli*, on the contrary, have such a pressing need for oxygen that they multiply mostly on the surface, very soon forming a membrane, while the liquid remains clear and in some cases a flocculent deposit is formed. Of course, I only apply these remarks to the *bacilli* arising spontaneously in these cultivations, since other varieties of this genus are sometimes met with having different characteristics.

EXPERIMENT No. 3.—*Effect of carbolic acid on development.*—Six test tubes were prepared March 19, 1880, as in the preceding experiments, and sufficient carbolic acid solution added to make their entire contents of the strength indicated below. Two tubes contained 2 per cent. of the acid, because a 90 per cent. solution was added to the first, and as it would not diffuse itself, a second tube was prepared with a more dilute solution; the former mixed perfectly after a few hours, however. To each of these tubes was added four drops of infusions containing the cultivated micrococci; they were then covered as before, and placed in an incubator heated to 90°–100° F.

Results of examination after six days.

Tube No. 14: 1 part carbolic acid to 400 of liquid. No membrane; considerable deposit and turbidity. Swarms with the micrococci throughout, though they are most numerous at the bottom.

Tube No. 15: 1 to 300. No membrane; turbid, with deposit. It is perfectly crowded with micrococci.

Tube No. 16: 1 to 200. No membrane; turbid, with deposit. Micrococci as above; a few *bacilli*.

Tube No. 17: 1 to 100. Membrane and turbidity: no deposit. Near the surface there are mostly *bacilli* and spores with a few micrococci; at the bottom the conditions are reversed and the micrococci are found in great numbers.

Tube No. 18: 1 to 50. Slight cloudiness of liquid; no membrane or deposit. Swarms with the micrococci in chains and various shaped aggregations—there are also some vibrios.

Tube No. 19: 1 to 50. Perfectly transparent and clear as when first placed in the incubator. Contains no sign of life. This was the tube in which the carbolic acid did not mix as soon as added; and it is probable that the micrococci when added descended to the bottom, and here came in contact with a solution of the acid much more concentrated than is indicated by the proportion used, and were thus destroyed.

A 1 per cent. solution of carbolic acid is not sufficient, therefore, either to destroy this organism or prevent its multiplication.

EXPERIMENT No. 4.—*Effect of carbolic acid on vitality.*—In experiment No. 3 we have seen that in one case the micrococci were able to multiply themselves in a solution containing even 2 per cent. of carbolic acid; in another case containing the same proportion of the disinfectant they did not multiply; were they simply hindered from developing while retaining their vitality, or were they destroyed? To answer this question, six watch-glasses were well flamed and in each was placed a few drops of a solution containing the micrococci, then sufficient of a strong solution of carbolic acid was added to make the whole of the strength indicated below. After standing one hour under a bell-glass the contents of each watch-glass were used for inoculating a tube prepared as in the other experiments, and this was kept at 90° F. for ten days.

Results of examination, April 1, 1880.

Tube No. 20: 1 to 400. Liquid turbid; very thin membrane and some deposit. Contains some *bacilli* and spores at the surface, but the micrococci abound and are particularly numerous at the bottom.

Tube No. 21: 1 to 300. Liquid slightly turbid; no membrane; some deposit. Many micrococci and some *bacilli* and spores.

Tube No. 22: 1 to 200. Liquid slightly turbid; no membrane; scanty deposit. Many clusters of micrococci mostly at the bottom.

Tube No. 23: 1 to 100. Liquid slightly turbid; no membrane; scanty deposit. Swarms with micrococci; there are also a few bacillus filaments.

Tube No. 24: 1 to 50. Liquid turbid; covered with a membrane; no deposit. At the surface were found a few micrococci, single and in chains, but deeper in the liquid; they could scarcely be discovered. My impression was that there were no more in the tube than were placed there by inoculation, and that consequently those found were incapable of multiplication, and, therefore, dead. There were many *bacilli* and their spores and some holobacteria (sprouting *bacilli?*).

Tube No. 25: 1 to 25. Slightly turbid; no membrane; scanty transparent deposit. A very few micrococci were found, but probably they were the ones added.

In this experiment there is a confirmation of the results of the preceding one, and it is proved that the micrococci are not affected by solutions containing 1 per cent. or less of carbolic acid. Two per cent. of the acid, however, seemed to destroy this organism, as in one of the tubes in the preceding experiment. If these micrococci, then, are the pathogenic agent, we cannot expect a weaker solution than 2 per cent. of carbolic acid to be of any value as a disinfectant.

EXPERIMENT NO. 5.—*Effects of borate of soda on development.*—In each of five test tubes was placed 20^{cc} of fresh urine, then five drops of a solution swarming with the micrococci, and, finally, sufficient of a 10 per cent. solution of borax to make the whole contain the proportion of the salt indicated below. The tubes were then covered with sheet caoutchouc and placed in an incubator at 95° for four days.

Results of examination, March 31, 1880.

Tube No. 26: 1 to 1,000. Liquid turbid; no membrane; slight deposit. Contains many micrococci.

Tube No. 27: 1 to 500. Liquid turbid; delicate membrane; slight deposit. Many micrococci and *bacilli.*

Tube No. 28: 1 to 300. Liquid cloudy with floating flocculi; no membrane; no deposit. Swarms with micrococci and *bacilli.*

Tube No. 29: 1 to 100. Liquid turbid; covered with a thin membrane; no deposit. Contains many clusters of micrococci, also *bacilli* and their spores—some of the rods show spore formation.

Tube No. 30: 1 to 50. Liquid clear with a slight transparent deposit. Only two small clusters of micrococci could be found, and no other bacteria forms were present. There had, consequently, been no multiplication of the organism.

A 2 per cent. solution of borax, therefore, prevents the growth of this micrococcus, having the same effect as a carbolic acid solution of the same strength. We have here an illustration of what may be expected of such studies as indications of treatment; these two substances having the same effect, borax would of course be preferable for internal use, since it can be given in twenty to thirty times the quantity.

EXPERIMENT NO. 6.—*Effect of benzoic acid on development.*—The experiment was conducted exactly as No. 5, with the exception that benzoic acid solution was used, containing 1¼ parts of borax to each part of acid to effect the solution of the latter, and the tubes remained five days in the incubator.

Results of examination, April 3, 1880.

Tube No. 31: 1 to 1,000. No membrane; liquid turbid; gelatinous deposit. Contains numbers of micrococci and a very few *bacilli.*

Tube No. 32: 1 to 500. Same appearance as No. 31. Contains clusters of micrococci and a very few bacillus spores.

Tube No. 33: 1 to 300. Same appearance as No. 31. Large numbers of micrococci, with a few vibrios and bacillus spores.

Tube No. 34: 1 to 100. Liquid perfectly clear, with the exception of a very transparent cloud near the bottom having the appearance of crystals. Under the microscope there could only be discovered a very few bacillus spores and a single rod. No micrococci.

Tube No. 35: 1 to 50. Appearance same as No. 34. One or two bacillus spores were the only organisms discovered.

A 1 per cent. solution of benzoic acid with borax, therefore, prevents the multiplication of these micrococci, and is, consequently, much more efficacious than carbolic acid.

EXPERIMENT NO. 7—*Effect of sulphate of quinine on development.*—Experiment conducted same as No. 5.

Results of examination.

Tube No. 36: 1 to 1,000. Liquid turbid, with a gelatinous cloud at the bottom. Contains micrococci, *bacilli* as rods and filaments, some of which are forming spores and vibrios.

Tube No. 37: 1 to 500. Appearance and contents same as No. 36.

Tube No. 38: 1 to 300. Liquid clear; a cloud of transparent substance resembling crystals floating near the bottom. A very few micrococci were found, but probably not more than were added.

Tube No. 39: 1 to 100. Liquid slightly turbid; scanty flocculent deposit. A very few micrococci and *bacilli* were found.

Tube No. 40: 1 to 50. Liquid perfectly clear. A very few micrococci.

From this experiment I have concluded that the one-third-of-a-per-cent. solution prevented the multiplication of the organism.

EXPERIMENT No. 8.—*Effect of quassia.*—Solid extract of quassia, dissolved and added to the tubes prepared as before, in the proportion named.

Tubes Nos. 41 to 45: 1 to 500; 1 to 300; 1 to 100; 1 to 50; 1 to 25. Liquid turbid; membrane and abundant deposit. All swarmed with the micrococci and considerable numbers of *bacilli* and bacillus spores.

EXPERIMENT No. 9.—*Effect of salicylic acid.*—Tubes prepared as before, to which were added salicylic acid containing 1½ parts of borax to each part of acid to cause solution.

Examination, April 3, 1880.

Tube No. 46: 1 to 1,000. Liquid turbid, with gelatinous-looking cloud near the bottom. Contains micrococci single and in couples, clusters and chains; also *bacilli.*

Tube No. 47: 1 to 500. Decidedly turbid. Contains bacilli and spores in considerable number, and only a very few micrococci.

Tube No. 48: 1 to 300. Appearance and contents same as in No. 47, except there are no micrococci.

Tube No. 49: 1 to 100. Liquid nearly clear. Contains many bacillus spores and rods, but no micrococci.

Tube No. 50: 1 to 50. Liquid perfectly clear. No organisms.

EXPERIMENT No. 10.—*Effect of chloride of zinc.*—Tubes prepared as before.

Tube No. 51: 1 to 3,000. Liquid turbid; abundant white deposit. Swarms with micrococci, with a few *bacilli* and vibrios.

Tube No. 52: 1 to 1,000. Liquid clear; white deposit. A few *bacilli* and spores were found, as also some dumb-bell bacteria, but none of the clusters or chains of micrococci.

Tube No. 53: 1 to 500. Liquid clear; no deposit. A very few bacillus spores were observed actively rotating, but no other sign of life.

Tubes Nos. 54, 55, *and* 56: 1 to 300; 1 to 100; 1 to 50. Liquid clear, with a brownish deposit and a little brownish matter floating on surface; under the microscope this seems to be of a crystalline nature. There had been no multiplication of micrococci.

EXPERIMENT No. 11.—*Effect of iodine.*—A 10 per cent. solution of iodine was made in distilled water, by first dissolving 20 per cent of iodide of potassium, and sufficient of this was added to the tubes prepared as before to make them contain the required quantity of iodine. These remained in the incubator four days at 95° F.

Results of examination.

Tube No. 57: 1 to 6,000. Liquid turbid. Contains micrococci in large numbers, mostly in chains; also, *bacilli* and spores.

Tube No. 58: 1 to 3,000. Liquid turbid. Micrococci in clusters and chains, but in small number; many *bacilli* and spores.

Tube No. 59: 1 to 1,000. Liquid clear, with a transparent cloud near the bottom of tube. Contains many *bacilli*, some of which seem to be breaking up into dumb-bell forms, elliptical spores, and a few micrococci.

Tube No. 60: 1 to 500. Liquid contains a transparent flocculent deposit. There are many *bacilli* and a few micrococci.

Tube No. 61: 1 to 300. Liquid transparent. No sign of living organisms.

Tube No. 62: 1 to 100. Liquid transparent and free from organisms.

EXPERIMENT No. 12.—*Effect of heat.*—In this experiment the contents of the tubes had the addition of two to three drops of a cultivation swarming with micrococci; the tubes were then closed and placed in a water bath at the temperature and for the time noted in the description of each tube. The tubes were then placed in an incubator, and kept at 95° F. for two days before examination.

Results of examination, April 10, 1880.

Tube No. 63: 130° F. for 15 minutes. Liquid turbid. Swarms with micrococci, and also contains a few *bacilli.*

Tube No. 64: 140° F. for 15 minutes. Liquid turbid; a gelatinous cloud near the bottom. Contains vast numbers of micrococci, with *bacilli*, elliptical spores, and vibrios.

Tube No. 65: 150° F. for 15 minutes. Liquid turbid; whitish deposit. No micrococci; contains only rod forms of bacteria.

Tube No. 66: 160° F. for 15 minutes. Appearance and contents of liquid similar to that in No. 65.

Tube No. 67: 208° F. for 5 minutes. Appearance of liquid and organisms found do not differ materially from No. 65.

OBSERVATION ON THE EFFECT OF VARIATIONS OF THE ATMOSPHERIC TEMPERATURE ON THE BODY TEMPERATURE IN HEALTH.

The temperature of animals is regarded with reason as a most important symptom in various contagious diseases; but it soon becomes evident to the observer that the temperature during health is subject to very considerable fluctuations. These are evidently due to what we may term internal and external causes. The most important of the former is probably the amount of liquid passed through the organism, and of the latter the variations of temperature of the atmospheric air and the amount of humidity which it contains. The following observations made on a healthy calf will, it is hoped, throw some light on the effect of atmospheric temperature.

Date.	Hour.	Atmospheric temperature.	Body temperature.
1879.		°F.	°F.
Dec. 1	7.45 a. m	34	99.75
	5.10 p. m	40	103.
2	7 a. m	20	98.75
	4.50 p. m	54	103.25
3	7 a. m	42	101.5
	5 p. m	58	103.
4	7.10 a. m	52	101.5
	5 p. m	56	102.75
5	7.15 a. m	54	101.75
	5 p. m	58	103.5
6	7.15 a. m	55	102.5
	5 p. m	54	102.75
7	7.50 a. m	36	101.25
	5 p. m	58	101.
8	7.25 a. m	33	100.5
	5 p. m	54	102.
9	7 a. m	42	101.75
	5 p. m	58	102.75
10	7.45 a. m	54	102.25
	5 p. m	62	103.5
11	7.45 a. m	58	102.75
	5. a. m	38	103.25
12	7 a. m	28	102.
	5.05 p. m	34	102.
13	7.15 a. m	28	101.
	5 p. m	40	101.25
14	8.20 a. m	40	10[illegible].25
	4.45 p. m	50	103.25
15	7.45 a. m	44	103.25
	5 p. m	40	102.25
16	7.45 a. m	32	100.25
	5 p. m	45	103.75
17	7.45 a. m	46	101.5

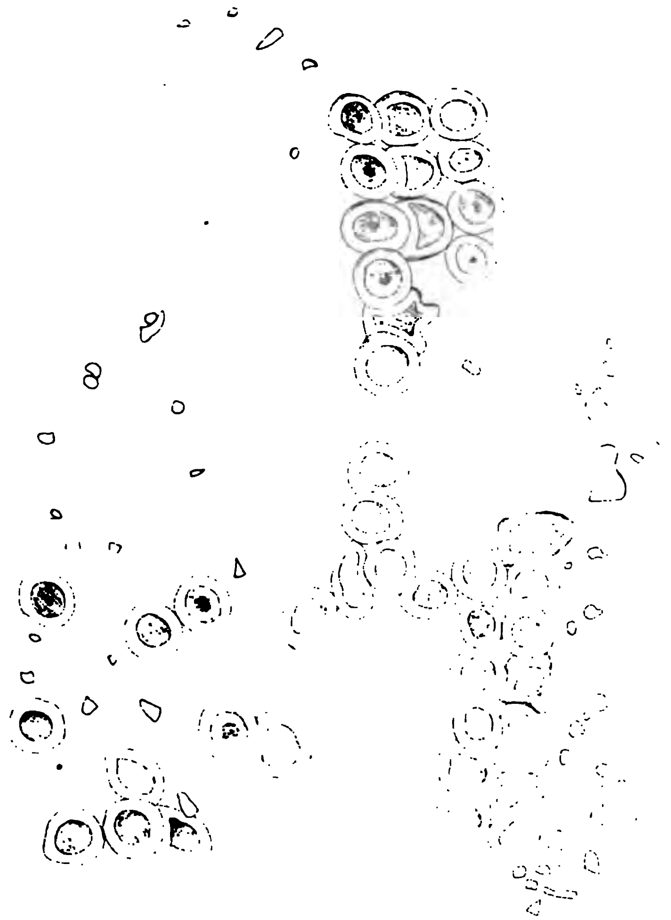
This gives an average morning body temperature of 101°.4, and an average evening temperature of 102°.7; being an average difference of 1°.3 between about seven in the morning and about five in the evening. The lowest temperature was 98°.75, and the highest 103°.75, a difference of five degrees, the animal being the whole time in good health. The lowest temperature of the body corresponded with the lowest of the atmosphere; and, in general, a considerable change in atmospheric temperature was followed by a change of body temperature in the same sense, though this did not always take place, and when it did there was no definite relation between the extent of the two changes. The eight mornings on which the atmospheric temperature was 40° or under, the average body temperature was 100°.72 and that of the air 31°.4; the nine mornings on which the atmospheric temperature was above 40°, the average body temperature was 101°.97, and that of the air 49°.7; thus an average increase of 18°.3 in the atmosphere caused an average increase of 1°.25 in body temperature. Again, the five evenings on which the atmospheric temperature was 40° or under, the average body temperature was 102°.35, and the average atmospheric temperature 38°.4; the eleven evenings on which the temperature of the air was above 40°, the average body temperature was 102°.86, and the average of the air 55°.2; an average increase of 16°.8 in evening temperature of the air, causing an average increase of 0°.51 in body temperature.

62	103.5
	102.75
28	103.25
	102.

Report Commissioner of Agriculture for 1880.

SWINE PLAGUE AND FOWL CHOLERA.

Microscopic Investigations by D.E. Salmon. D.V.M. Plate I.



Salmon, Del.

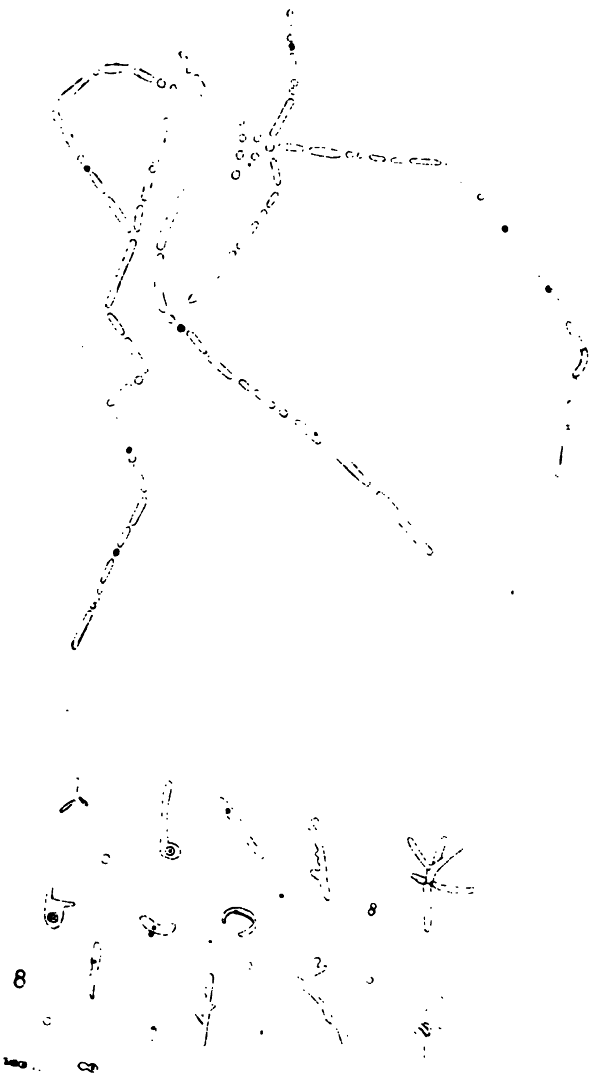
Fig. 1. Swine - Plague: Blood from living animal containing particles of fibrin. × 1200 diam.

A Hoen & Co. Lithocaustic. Baltimore

Report Commissioner of Agriculture for 1880.

SWINE PLAGUE AND FOWL CHOLERA.

roscopic Investigations by D.E. Salmon. D.V.M. Plate II.



Salmon, Del.

Fig. 2. Swine-Plague: Organisms in preparation of blood from jugular 4 days old. Bacilli forming granules by fission.. x 1000 diam.

A. Hoen & Co Lithocaustic. Balt.

Report Commissioner of Agriculture for 1880.

SWINE PLAGUE AND FOWL CHOLERA.

Microscopic Investigations by D.E. Salmon, D.V.M. Plate III.

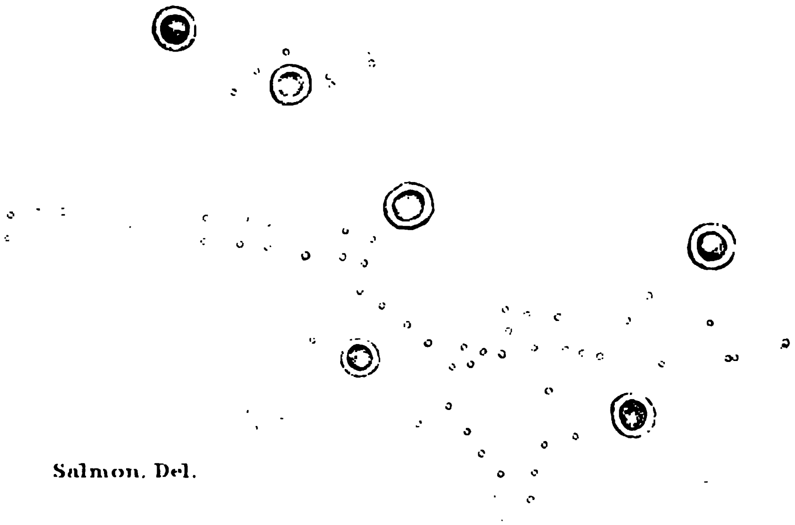
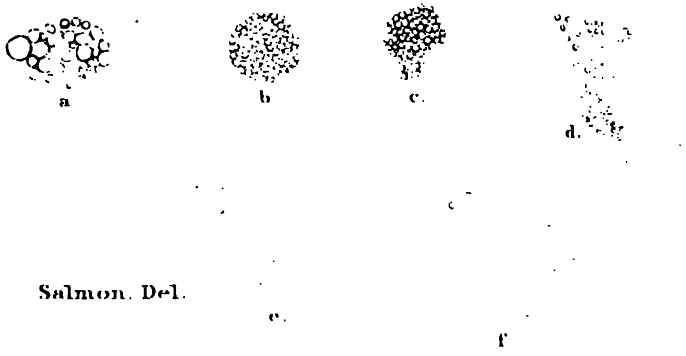

Salmon. Del.

Fig. 3. Swine Plague: Relative number of granules and blood corpuscles. From part of a field in the same preparation in which were found the organisms of fig. 2. x 1000 diam.



Salmon. Del.

Fig. 4. Swine Plague: Formation of granules or plastids by wandering cells (leucocytes) in bronchial mucus. a, fat granules; b, c, d, e, f, consecutive stages in the dispersion of the uniform granules (plastids). x 1000 diam.

A. Hoen & Co. Lithocaustic, Baltimore

SWINE PLAGUE AND FOWL CHOLERA.

Microscopic Investigations by D.E. Salmon, D.V.M. Plate IV.

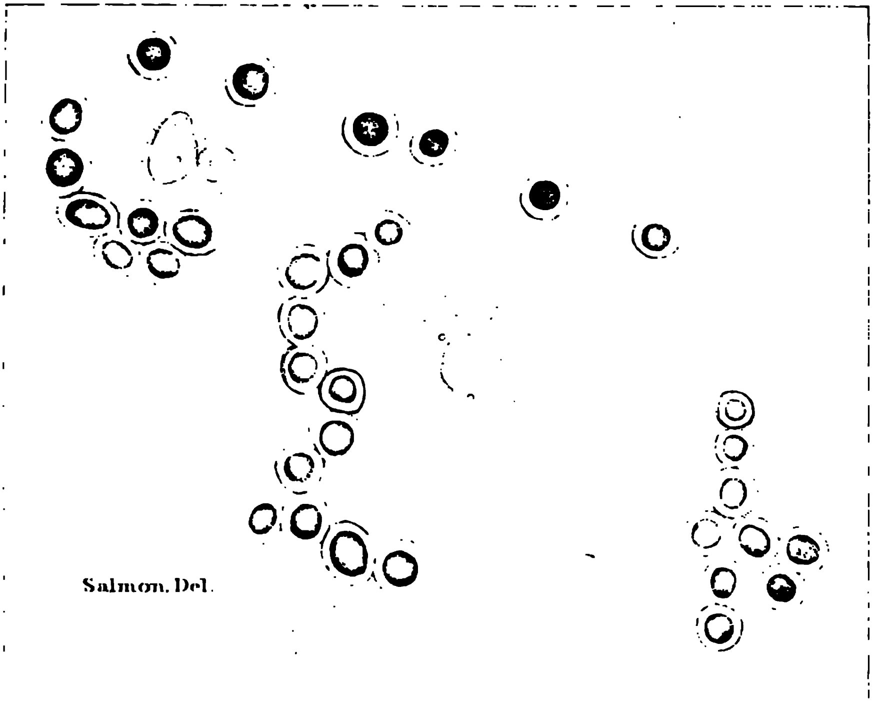


Fig. 5. Swine-Plague: Clusters of leucocytes and granules in blood. x 1000 diam.

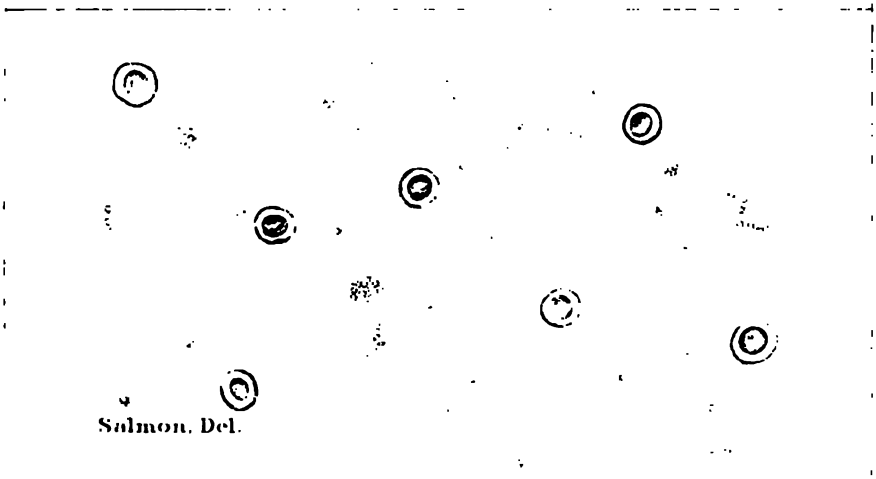


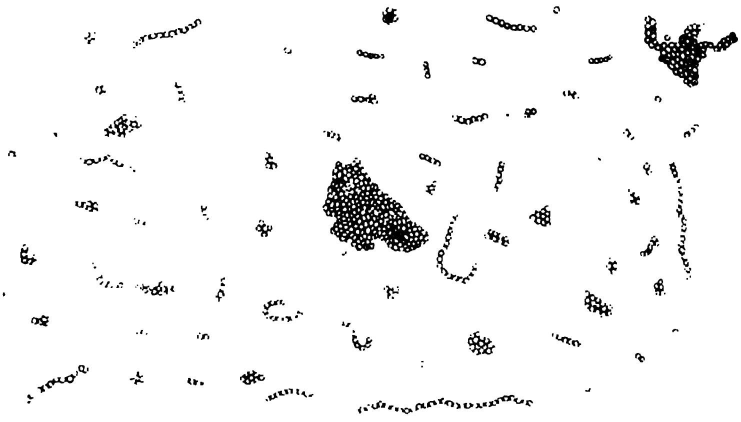
Fig. 6. Swine Plague: Blood of hog killed near Charlotte, N.C. July 2 1880. Vacuum tube filled from vein and hermetically sealed ten days before examination. x 1000 diam.

A.Hoen & Co. Lithocaust. Baltimore

Report Commissioner of Agriculture for 1880.

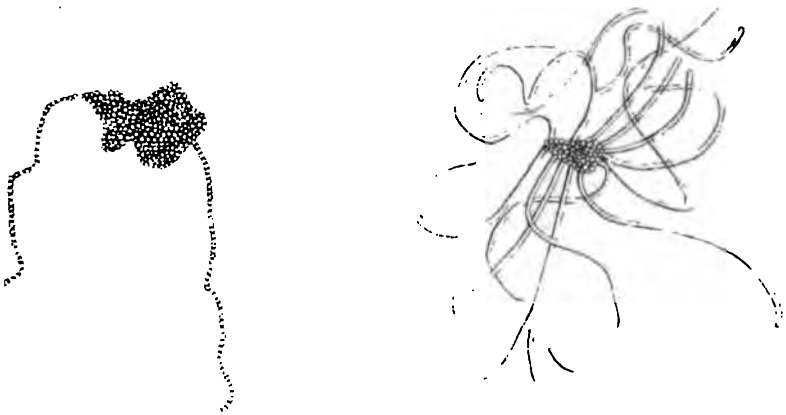
SWINE PLAGUE AND FOWL CHOLERA.

oscopic Investigations by D.E. Salmon. D.V.M. Plate V.



Salmon, Del.

Fig. 7. Swine-Plague: Virus after seven days cultivation in urine. x 1000 diam.



Salmon, Del.

Fig. 8. Swine Plague: Exceptional forms developed in cultivations of virus in urine. x 1000 diam.

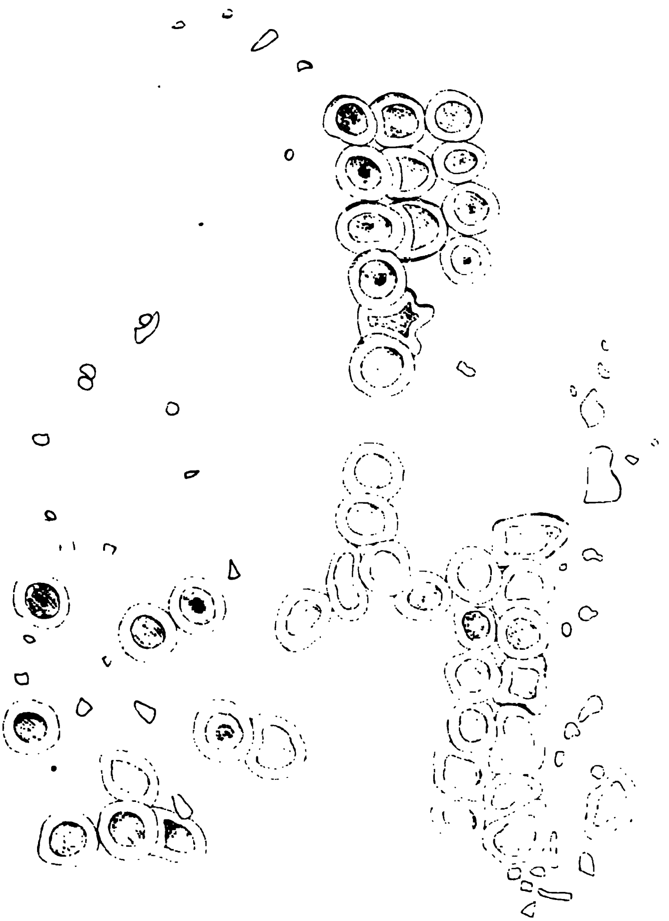
A.Hoen & Co. Lithocaustic Baltimore

[illegible]	[illegible]
62	103. 5
8	102. 75
38	103. 25
	102.

Report Commissioner of Agriculture for 1880.

SWINE PLAGUE AND FOWL CHOLERA.

Microscopic Investigations by D. E. Salmon. D.V.M. Plate I.



Salmon, Del.

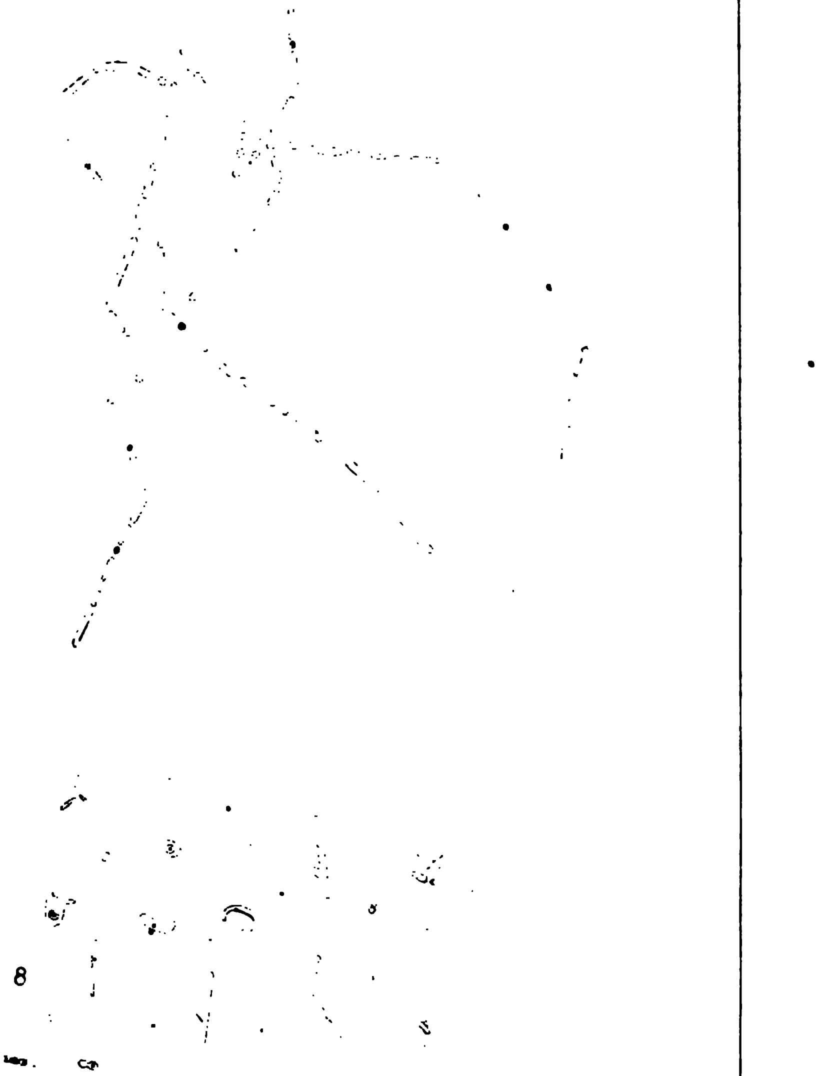
Fig. 1. Swine - Plague: Blood from living animal containing particles of fibrin. x 1200 diam.

A Hoen & Co. Lithocaustic. Baltimore

Report Commissioner of Agriculture for 1880.

SWINE PLAGUE AND FOWL CHOLERA.

Microscopic Investigations by D.E. Salmon. D.V.M. Plate II.



Salmon. Del.

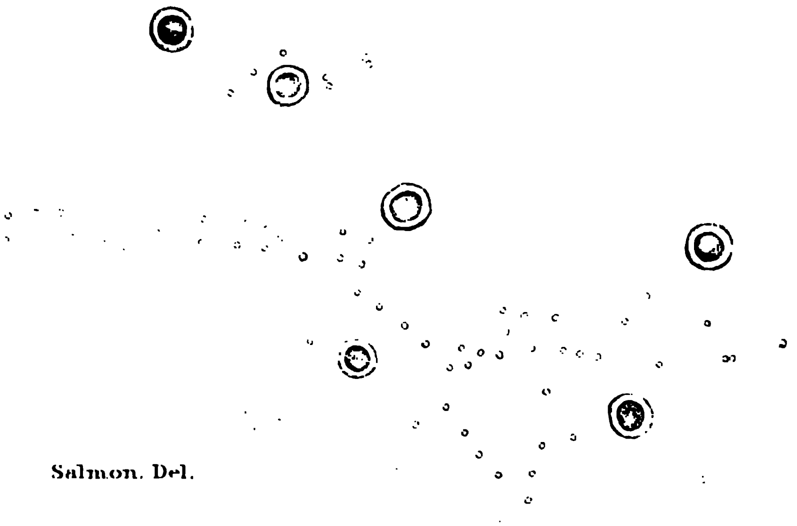
Fig. 2. Swine-Plague: Organisms in preparation of blood from jugular 4 days old. Bacilli forming granules by fission.. × 1000 diam.

A. Hoen & Co. Lithocaustic Baltimore

Report Commissioner of Agriculture for 1880.

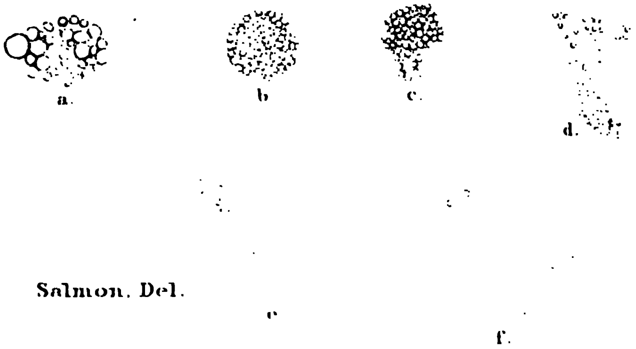
SWINE PLAGUE AND FOWL CHOLERA.

Microscopic Investigations by D.E. Salmon. D.V.M. Plate III.



Salmon. Del.

Fig. 3. Swine-Plague: Relative number of granules and blood corpuscles. From part of a field in the same preparation in which were found the organisms of fig. 2.
x 1000 diam.



Salmon. Del.

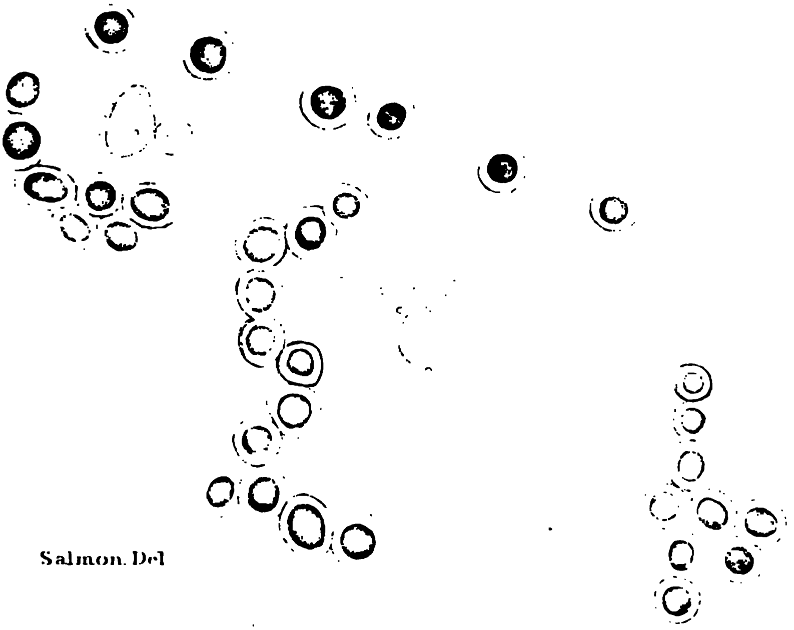
Fig. 4. Swine Plague: Formation of granules or plastids by wandering cells (leucocytes) in bronchial mucus. a, fat granules; b, c, d, e, f, consecutive stages in the dispersion of the uniform granules (plastids).
x 1000 diam.

A.Hoen & Co. Lithocaustic Baltimore

Report Commissioner of Agriculture for 1880.

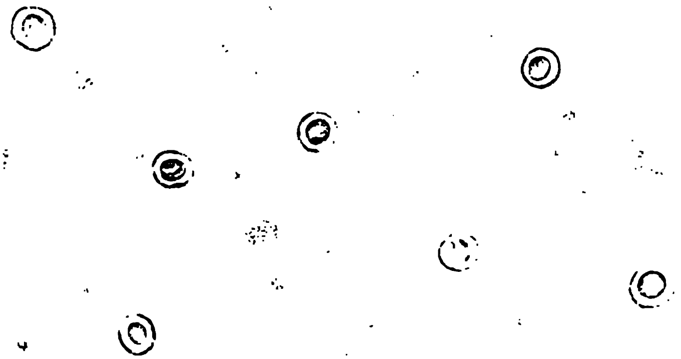
SWINE PLAGUE AND FOWL CHOLERA.

Microscopic Investigations by D.E. Salmon. D.V.M. Plate IV.



Salmon. Del

Fig. 5. Swine Plague: Clusters of leucocytes and granules in blood. x 1000 diam.



Salmon. Del.

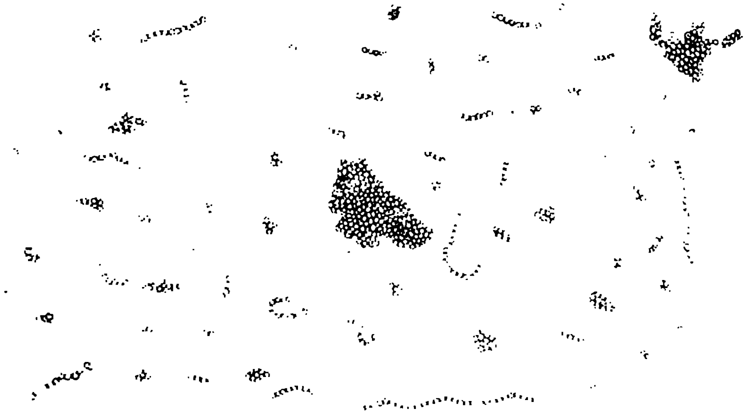
Fig. 6. Swine Plague. Blood of hog killed near Charlotte, N.C. July 2 1880. Vacuum tube filled from vein and hermetically sealed ten days before examination x 1000 diam

[illegible]

Report Commissioner of Agriculture for 1880.

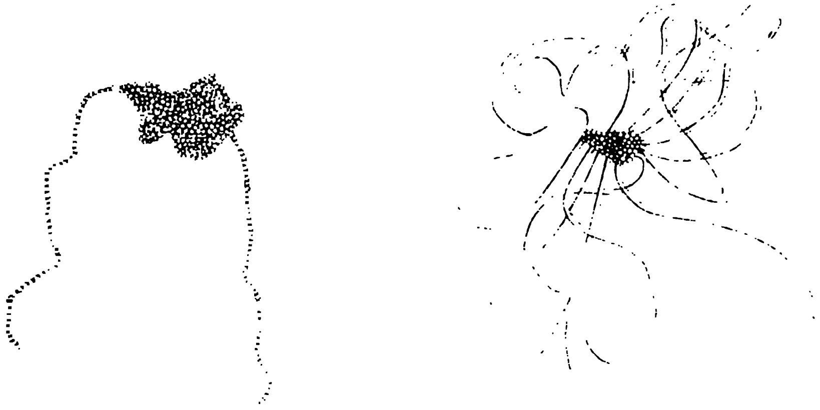
SWINE PLAGUE AND FOWL CHOLERA.

Microscopic Investigations by D.E. Salmon. D.V.M. Plate V.



Salmon, Del.

Fig. 7. Swine-Plague: Virus after seven days cultivation in urine. x 1000 diam.



Salmon, Del.

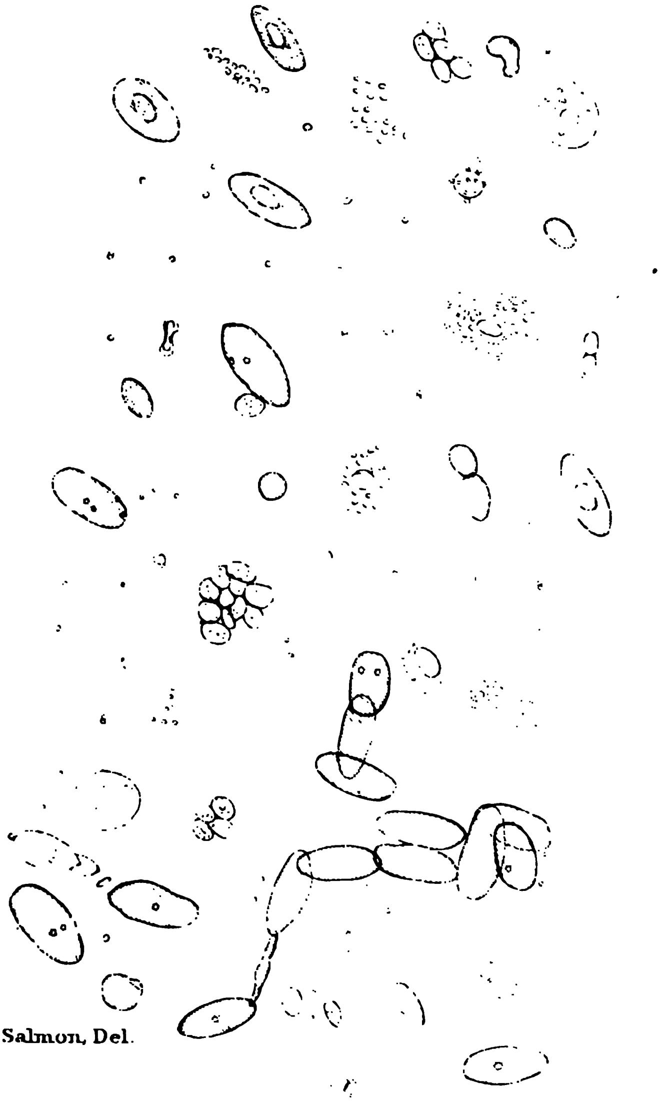
Fig. 8. Swine Plague: Exceptional forms developed in cultivations of virus in urine. x 1000 diam

A Hoen & Co. Lithocaustic. Baltimore

Report Commissioner of Agriculture for 1880.

SWINE PLAGUE AND FOWL CHOLERA.

icroscopic Investigations by D.E. Salmon. D.V.M. Plate VI.



Salmon, Del.

Fig. 9. Fowl-Cholera: Blood from Chicken nearly dead, drawn from vein and immediatly examined Aug 28, 1880.
x 1000 diam.

A Hoen & Co. Lith. Caustic. Baltimore

Report Commissioner of Agriculture for 1880.

SWINE PLAGUE AND FOWL CHOLERA.

croscopic Investigations by D.E.Salmon.D.V.M. Plate VII.

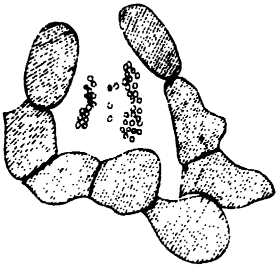


Fig. 10. Fowl - Cholera:
Moving granules. x 1000.

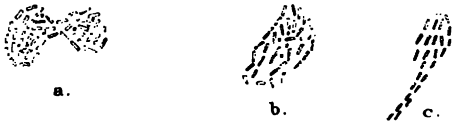


Fig. 11. Fowl - Cholera:
Moving clusters of rod - shaped granules, a, b, & c, successive forms rapidly assumed by the same cluster. x 1000.

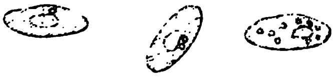


Fig. 12. Fowl - Cholera:
Granules about the nuclei of red globules. x 1000.

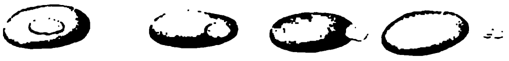


Fig. 13. Fowl - Cholera:
Osmic acid preparation, showing escape of the nuclei. x 1000.

A.Hoen & Co. Lithocaustic. Baltimore.

Report Commissioner of Agriculture for 1880.

SWINE PLAGUE AND CHICKEN CHOLERA.

icroscopic Investigations by D. E. Salmon. D.V.M. Plate VIII.

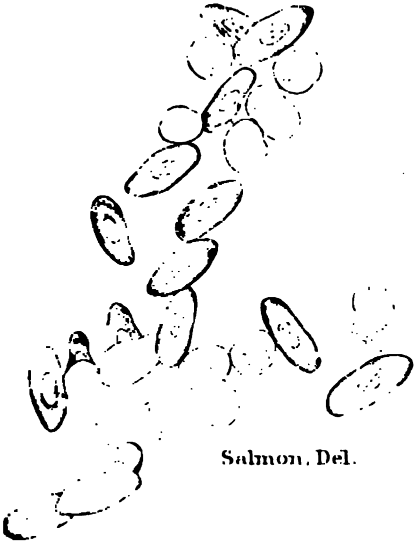


Fig. 14. Fowl-Cholera: Osmic acid preparation from same blood as fig. 9. Shows the large number of leucocytes and absence of free granules and free nuclei x 1000 diam.

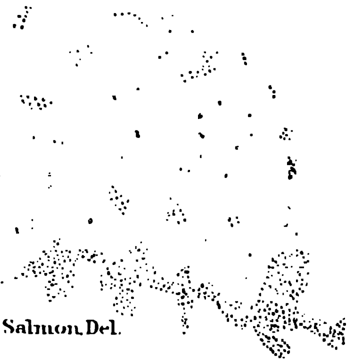


Fig. 15. Fowl-Cholera: Appearance of cultivation in moist chamber on slide 20 hours in the incubator. x 600 diam.

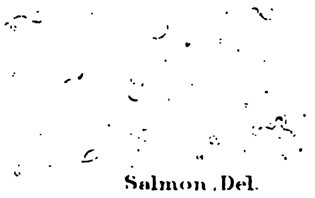


Fig. 17. Fowl-Cholera: Organisms existing in vast number in the excrement. x 1000 diam.

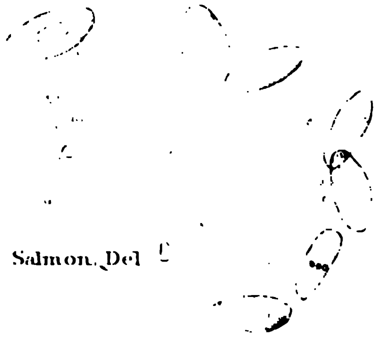


Fig. 18. Fowl-Cholera: Organisms in blood similar to those of excrement. From preparation made Sept. 26. 1880. x 1000 diam.

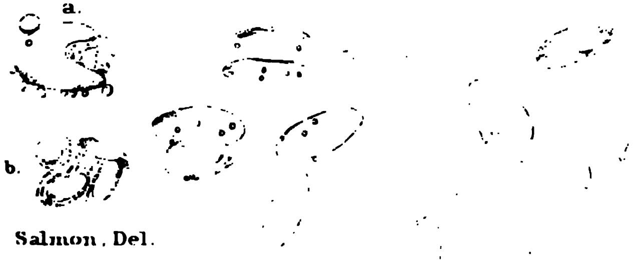


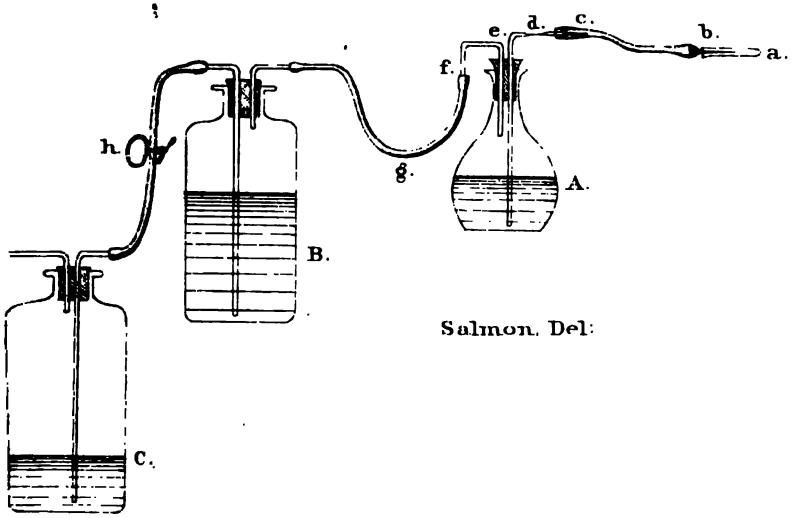
Fig. 16. Fowl-Cholera: Destruction of red corpuscles by leucocytes. a, Soon after contact; b, the same corpuscle ten minutes later. x 1000 diam.

A. Hoen & Co. Lithocaustic Baltimore

Report Commissioner of Agriculture for 1880.

SWINE PLAGUE AND CHICKEN CHOLERA.

Microscopic Investigations by D.E. Salmon. D.V.M. Plate IX.



Salmon, Del:

Fig. 19. - Apparatus for introducing blood directly from the veins to a cultivation liquid to avoid contamination with atmospheric germs. A. cultivation flask; b, aspirator needle; a, glass cup packed with cotton. c point to be broken within the caoutchouc tube; d, part drawn thin to divide and seal with lamp after blood is introduced. e, ventilating tube packed with cotton at f; B and C, aspirator jars.

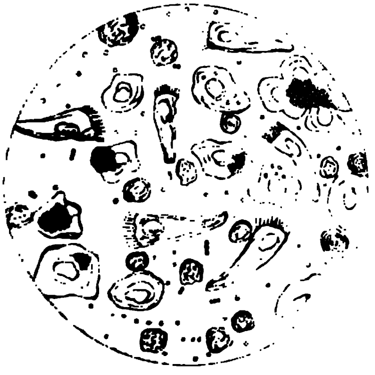


Fig. 20. - Swine-plague: Bronchial mucus (after Mégnin). × 600 to 700 diam.

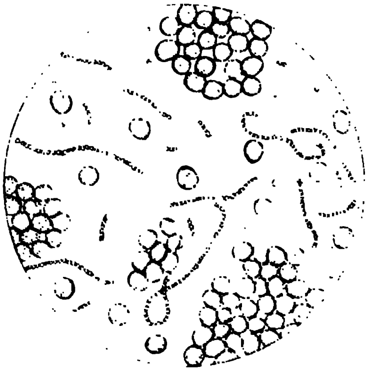


Fig. 21. - Swine-plague. Blood (after Mégnin). × 600 to 700 diam.

A Hoen & Co. Lith. Caustic. Baltimore

Report Commissioner of Agriculture for 1880.

SWINE PLAGUE AND CHICKEN CHOLERA.

Microscopic Investigations by D.E. Salmon. D.V.M. Plate X.

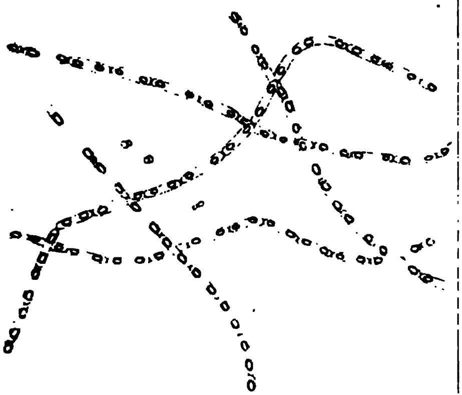


Fig. 22. - Bacillus anthracis: Spore formation after 16 hours cultivation (after Toussaint.) × 500.

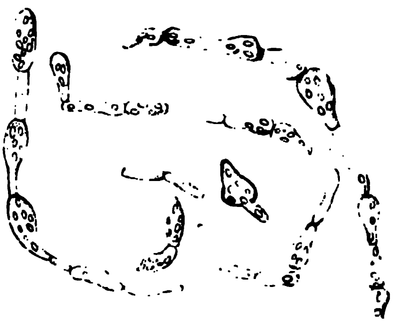


Fig. 23. - Bacillus anthracis: Sporangial forms obtained in serum of dog's blood (after Toussaint.) × 500.

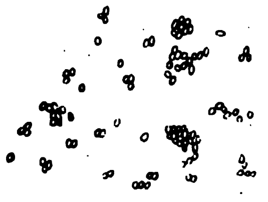


Fig. 24. - Bacillus anthracis: Isolated spores (after Toussaint) × 500.

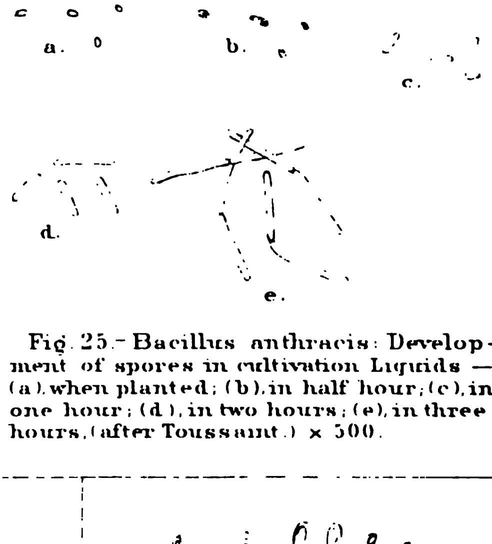


Fig. 25. - Bacillus anthracis: Development of spores in cultivation Liquids — (a), when planted; (b), in half hour; (c), in one hour; (d), in two hours; (e), in three hours. (after Toussaint.) × 500.

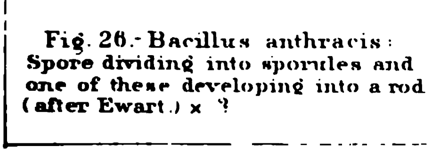


Fig. 26. - Bacillus anthracis: Spore dividing into sporules and one of these developing into a rod (after Ewart.) × ?

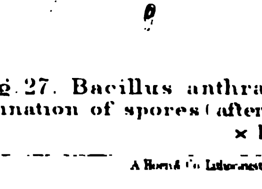


Fig. 27. Bacillus anthracis. Germination of spores (after Cohn) × 1650.

A Hoen & Co Lithocaustic Baltimore

INVESTIGATION OF SWINE PLAGUE.

Third Report of Dr. James Law.

Hon. Wm. G. Le Duc,
Commissioner of Agriculture:

Sir: I have the honor to submit a report of experiments on swine plague, undertaken with the view of determining how far the virus can be mitigated by artificial means, so that the disease may be made to assume a mild or harmless form, and how far such mitigated type of the malady will prove protection against the effect of a second exposure to infection. That I have succeeded in securing such protection it is perhaps as yet too much to assert, yet observation seems to show that inoculation with the virus which has been cultivated in certain organic solutions is attended by little danger to the animal, and yet produces a condition of the system which is protection against the dangers of a renewed exposure to infection, and also against the perils usually attending inoculation with a moderate amount of the ordinary or native virus. It has shown none the less clearly that the poison as cultivated in certain other organic mixtures becomes very deadly; that the virus that has been shut up for some time, with a limited amount of air, is no less so, and that the introduction into the system of a maximum dose of the more potent forms of the poison will put all protective measures to naught.

The work has necessarily been slow because of the delay needful to allow of the action of the poison on the animal system and the full recovery from the same, and afterward by reason of the time necessary to submit the convalescent animals to the tests required to ascertain the existence and measure of the acquired insusceptibility, and also because the number of subjects was limited, so that each might be kept apart from dangerous infection during the early stages of the experiment. Further delay necessarily occurred when an experiment turned out adversely to our hopes, and necessitated a change of base and a new and different line of investigation.

In submitting the results of this work I have furnished the record of each experiment separately, with comments, and wound up by a summary of deductions, which will serve as a basis for experiments on a larger scale.

Pig No. 1.

Small Berkshire pig, obtained from Mr. Frear, is out of a small herd, of which three have died of swine plague, introduced by a purchase from New Jersey. This and another, the only survivors of the herd, I secured for experiment. It had not been thought seriously ill, but looked emaciated and scoured on arrival.

Date.	Time.	Body temperature,—rectum.	Remarks.
1880.		°F.	
June 9	....	103	Fed green vegetables, corn meal, and bread.
10	9 a. m........................	102	Scours; looks ill.
	6 p. m........................	103	Do.
11	9 a. m........................	104	Do.
12	m	102	Scours; looks ill; fed shorts.
13	9 a. m........................	101. 5	Do.
14	....do	101. 75	Hearty; hungry; bowels settled.
15	....do	101. 75	Do.
16	....do	101. 75	Do.
17	....do	101. 5	
18	....do	101. 5	
19	....do	101. 5	
20	....do	101. 5	
21	....do	102	
22	....do	101. 75	
23	6. 30 p. m	102. 5	Inoculated with lung liquids of sick pig. Killed to-day at Horseheads. See microscopic drawings, figs. 1, 2, 3.
24	9 a. m........................	101. 5	Swelling where inoculated. Weak grunt.
25	....do	101. 5	
26	....do	101. 75	
27	....do	102. 5	
28	....do	102	
29	....do	101. 5	
	6 p. m........................	102	
30	9 a. m........................	101. 5	
	6 p. m........................	102	
July 1	9 a. m........................	101. 75	Inoculation swelling persists.
2	....do	101. 5	Purging, but good appetite.
	6 p. m........................	102	Do.
3	9 a. m........................	101. 5	Do.
	6 p. m........................	101. 5	Do.
4	9 a. m........................	101	Do.
	6 p. m........................	101. 5	Do.
5	9 a. m........................	102	Do.
	6 p. m........................	103	Purging badly digested matter; greenish water with floating solids.
6	9 a. m........................	100	
	6 p. m........................	102	Purging; scurfy; skin exudation.
7	9 a. m........................	103. 75	Do.
	6 p. m........................	103. 5	Do.
8	9 a. m........................	100	Purging; scurfy; very feverish grunt.
9	....do	99	Purging; looks much worse.
	6 p. m........................	105	Do.
10	9 a. m........................	100	Inoculated with peritoneal exudate of a pig killed 8 days ago in North Carolina, by Dr. Salmon. Kept in vacuum tube till 36 hours ago. Smells of hog, but not putrid.
	6 p. m........................	103	
11	9 a. m........................	102	
	6 p. m........................	100	Very dull and prostrate.
12	9 a. m........................	101. 5	
13	....do	101	
14	....do	100	Very sick; likes to be rolled over. Stands drawn together, with back arched and nose extended.
15	6 p. m........................	99	Very prostrate, weak grunt, purges.
16	....do	98	Very weak; has to be raised.
17	9 a. m........................	100. 5	Unable to rise. Seems just breathing.
	12 noon........................	....	Found dead.

POST-MORTEM EXAMINATION SAME AFTERNOON.

Rigor mortis slight. Skin thin and bloodless, covered with a thick black exudation dried at most points and scaling off. The left ear, where it had been punctured two weeks ago for a drop of blood, presents a small slough about a line in diameter, and when pressed exudes a drop of white pus-like matter.

The seat of the first inoculation in the flank exudes a few drops of a red grumous and contains a yellowish white slough inclosed in a sac with thick bluish white

The seat of the second inoculation, situated in front of the last and close to the costal cartilages, presents an abscess with ½ drachm of a whitish purulent fluid, and inclosed by thickened whitish fibroid walls. Immediately below this the muscular walls of the abdomen by the span of an inch long by half an inch broad have undergone extensive thickening and fibroid degeneration.

Superficial inguinal glands are deeply pigmented, presenting a dark blue tinge. Enlargement very slight.

The *sublumbar*, *gastric*, and *mesenteric glands* are similarly pigmented The *prescapular glands* are deeply pigmented The *prethoracic glands* congested, of a deep red color. The *pharyngeal submaxillary glands* pigmented. *Mouth* and *pharynx* normal.

Stomach: Great curvature has the mucous membrane red and congested.

Small intestine shows partial congestion.

Cæcum shows a number of sloughing ulcers. The sloughs are of a yellowish white color, and do not project much above the adjacent mucous membrane.

Colon has fewer and smaller sloughs of the same general character.

The cæcum and anterior part of the colon contain many whipworms (*Tricocephalus dispar*).

Lungs normal or nearly so. The right is of a dark red color, from a congestion which is manifestly hypostatic and post-mortem.

Right heart contains a small clot. Left heart empty.

Spleen normal.

Kidneys and *Wolffian bodies* congested and red. There a is great deficiency of fat throughout the body.

REMARKS ON PIG NO. 1.

This pig came into my possession as a sick animal, and was besides small and badly nourished. Fourteen days later, when it had been manifestly improving for a week, it was inoculated by injecting under the skin a drachm of the fresh pulmonary exudate of a sick (swine plague) pig killed the same day at Horseheads. It seemed important to test the insusceptibility of the animal at this early stage of recovery, as the companion pig No. 2 being now in a more advanced state of convalescence (by about ten days), furnished the opportunity for a comparison. The immunity or insusceptibility acquired by swine that had passed through the disease and fully recovered we took for granted on the testimony of men of experience, so that the question with us, and which those pigs seemed to offer a chance of determining, was at how early a date after the attack could this immunity be counted on.

In inoculating as stated, with such a large amount of the virulent liquid, we made the test one of the most severe possible, and one much more exacting than if we had simply placed the experimental pig in the same pen with a sick one, or inserted a single drop of the virulent liquid under the skin. In his experiments with anthrax, Chauveau has shown that the probability of a fatal result is far greater if the virus is introduced, as in this case, in a large quantity at a time, than after even a succession of inoculations of a limited amount.

By a parity of reasoning, it is probable that the swine plague, which is presumed to be caused, like anthrax, by bacteridian infection, will show itself to be subject to the same laws of development and prophylaxis, and therefore the sudden saturation of the blood with a drachm of virulent fluid was much more likely to bear down all protective opposition than if the poison had gained access to the system through the natural channels as infinitesimal particles floating in the air, or as virulent liquids that might come in contact with any chance sore on the surface.

The case No. 1, which terminated unfavorably, clearly established two points: 1st. That the protection furnished to an animal by a first attack of the disease, even when that is contracted in the natural manner, is not yet secured so long as the system is still suffering from the active effects of such first attack. 2d. That a very large dose of the virus of swine plague manifestly acts on the system with greater potency than a small one.

Both of these conclusions were still further strengthened by the results of a second inoculation practiced seventeen days after the first, and while the system was still profoundly affected by the latter. The patient sank rapidly after the second inoculation, and died on the seventh day, presenting at the necropsy the characteristic lesions of the plague.

LARGE BERKSHIRE PIG, NO. 2.

Sent me from Mr. Frear's, June 9, 1880, from a herd that was infected with hog cholera by a purchase of some hogs from New Jersey. This pig has been sick but is recovering. This and No. 1 are the sole survivors of the herd. On arrival it was still plump and hearty, the main signs of disorder being an extra exudation from the skin and a very slight irregularity of the bowels.

Date.	Time.	Body temperature.	Remarks.
1880.		° F.	
June 9		104	Bowels slightly irritable.
10	9 a. m	103.5	
10	6 p. m	103.2	
11	9 a. m	104	
12	M	102	Bowels settled. Fed shorts.
13	9 a. m	102	
14	....do	101.5	
15	....do	101.5	
16	....do	101.5	
17	....do	101.5	
18	....do	101.5	
19	....do	101.5	
20	....do	101.5	
21	....do	101.5	
22	....do	101.5	
23	6.30 p. m	103	Inoculated with diseased lung of pig killed at 1 p. m. the same day at Horseheads; ½ drachm of the liquid injected under the skin.
24	9 a. m	101.5	Slight swelling in seat of inoculation.
25	....do	101.5	
26	....do	101.5	
27	....do	103	
28	....do	102	
29	....do	102.5	
29	6 p. m	104	Swelling in seat of inoculation hard and 1½ inches in diameter.
30	9 a. m	103	
30	6 p. m	104	
July 1	9 a. m	102	Inoculation swelling red; its bristles shed.
2	....do	101.5	Abrasion on swelling, with oozing of serum.
2	6 p. m	103	Excellent appetite.
3	9 a. m	101.5	
3	6 p. m	102	
4	9 a. m	101	
4	6 p. m	102	
5	9 a. m	103	Wound dry. Swelling less but very itchy. Skin harsh, scaly.
5	6 p. m	103	
6	9 a. m	101	Coughs.
6	6 p. m	103.75	Coughs. Unctuous, blackish skin exudation.
7	9 a. m	103	
7	6 p. m	103	
8	9 a. m	101	
9	....do	103	
9	6 p. m	104.5	
10	9 a. m	103	Inoculated with peritoneal exudate from sick pig in North Carolina; virus kept 8 days in vacuum tube and smells strongly of pig, but not fœtid; ½ drachm injected hypodermically.
10	6 p. m	104.9	
11	9 a. m	104.9	Swelling where inoculated 7 hours after the injection.
11	6 p. m	103	
12	9 a. m	104.75	
13	....do	104	
14	....do	103	

LARGE BERKSHIRE PIG, No. 2—Continued.

Date.	Time.	Body temperature.	Remarks.
1880.		°F.	
July 15	6 p. m	103	
16	....do	104	Looks hearty. Only slight swelling where last inoculated. Skin scurvy, itchy.
17	9 a. m	101.5	
17	6 p. m	101	
18	9 a. m	104.4	
18	6 p. m	103.75	
19	9 a. m	100.5	
19	6 p. m	104	
21	9 a. m	102.5	
22	....do	104	
22	6 p. m	102	
23	9 a. m	101	
23	6 p. m	103.75	
24	9 a. m	102.25	
24	6 p. m	105	After supper.
25	9 a. m	103	
25	6 p. m	105.25	Do.
26	9 a. m	103	
26	6 p. m	104	
27	9 a. m	102.25	Liquids taken from inoculation swelling. See microscopic drawing, fig. 4.
27	6 p. m	103	
28	9 a. m	101.75	
28	6 p. m	103.5	
29	9 a. m	101	
29	6 p. m	103.5	
30	9 a. m	102	
30	6 p. m	104	
31	9 a. m	102	
31	6 p. m	105	Had several fits of coughing.
Aug. 1	9 a. m	102	
1	6 p. m	103	
2	9 a. m	102.75	
2	6 p. m	103.5	Weather set in cold.
3	9 a. m	101.25	Cold and wet.
3	6 p. m	103	Do.
4	9 a. m	100	Do.
4	6 p. m	103.25	
5	9 a. m	101	
5	6 p. m	103	
6	9 a. m	102	
6	6 p. m	104	
7	9 a. m	101.5	
7	6 p. m	103.5	
8	9 a. m	101	
8	6 p. m	103	
9	9 a. m	105	
9	6 p. m	104.75	
10	9 a. m	102	
10	6 p. m	104.75	
11	9 a. m	102.75	
11	6 p. m	103.75	Purges.
12	9 a. m	102	
12	6 p. m	103.25	
13	9 a. m	102.5	
13	6 p. m	103.75	
14	9 a. m	102.25	Pus from inoculation swelling has rods (bacillus) without motion.
14	6 p. m	102.5	Inoculated on No. 3.
15	9 a. m	100.5	Cold and showery.
15	6 p. m	103.25	
16	9 a. m	100	Cold and dry.
16	6 p. m	103.5	
17	9 a. m	101	Cold.
17	6 p. m	104	
18	9 a. m	102.5	Cold, threatening.
18	6 p. m	103.5	
19	9 a. m	102.25	Wet and warm.
19	6 p. m	103	
20	9 a. m	102	Wet—warm.
20	6 p. m	102.75	
21	9 a. m	102.75	Warm—muggy.
21	6 p. m	103	
22	9 a. m	102	Clear.
22	6 p. m	104	
23	9 a. m	102	
23	6 p. m	104	
24	9 a. m	102.4	

LARGE BERKSHIRE PIG, No. 2—Continued.

Date.	Time.	Body temperature.	Remarks.
1880.		°F.	
Aug. 24	6 p. m	104	
25	9 a. m	102	
25	6 p. m	102.5	
26	9 a. m	101.75	
26	6 p. m	102.75	
27	9 a. m	102	
27	6 p. m	102.75	
28	9 a. m	102.5	
28	6 p. m	104.75	
29	9 a. m	102.75	
29	6 p. m	104	
30	9 a. m	102.5	
30	6 p. m	104	
31	9 a. m	102	
31	6 p. m	103.5	
Sept. 2	9 a. m	102.25	Inoculated with virus from sick pig in North Carolina; kept three days in wheat bran.
2	6 p. m	103.5	
3	9 a. m	102	
3	6 p. m	103	
4	9 a. m	102.25	
4	6 p. m	103.5	
5	9 a. m	102	Slight swelling where inoculated.
5	6 p. m	102.5	
6	9 a. m	102	
6	6 p. m	102.75	
7	9 a. m	102.25	
7	6 p. m	103	
8	9 a. m	102	
8	6 p. m	103	
9	9 a. m	102	
9	6 p. m	103.25	
10	9 a. m	102.25	
10	6 p. m	102.75	
18	6 p. m	104	Dull. Has purged and been irritable during the last week. Inoculated right ear with drop of virus, partly septic, from Camden, N. J.
19	9 a. m	103	
19	6 p. m	104	
20	9 a. m	102.5	Slight swelling where inoculated.
20	6 p. m	104.25	
21	9 a. m	102	
21	6 p. m	103	
22	9 a. m	101	
22	6 p. m	102	
23	9 a. m	101.5	
23	6 p. m	102	
24	9 a. m	101	Slight oozing where last inoculated.
24	6 p. m	102	
25	9 a. m	100.5	Feeds less than before inoculation.
25	6 p. m	102.75	
26	9 a. m	100	
26	6 p. m	102	
27	9 a. m	100.5	
27	6 p. m	102	
28	9 a. m	100	
28	6 p. m	100	
29	9 a. m	100.5	
29	6 p. m	101.5	
31	9 a. m	100	
31	6 p. m	101	
Oct. 1	9 a. m	100.25	
1	6 p. m	101	
2	9 a. m	101	Appetite fails.
2	6 p. m	103	
3	9 a. m	102.5	
3	6 p. m	104	Black circular spots inside the thighs; leave slight abrasions where scraped off.
4	9 a. m	102	
4	6 p. m	103	
5	9 a. m	100	
5	6 p. m	101	
6	9 a. m	100	
6	6 p. m	101	
7	9 a. m	100	
7	6 p. m	100	
8	9 a. m	100.05	
8	6 p. m	101.75	
9	9 a. m	101	
9	6 p. m	101.75	

LARGE BERKSHIRE PIG, No. 2—Continued.

Date.	Time.	Body temperature.	Remarks.
1880.		° F.	
Oct. 10	9 a. m	101	
10	6 p. m	102.5	
11	9 a. m	100	
11	6 p. m	101	
12	9 a. m	100	
12	6 p. m	100	
13	9 a. m	99	
13	6 p. m	99.5	
14	9 a. m	100	
14	6 p. m	101	
15	9 a. m	102	
15	6 p. m	102	
16	9 a. m	100	
16	6 p. m	101	
17	9 a. m	100	
17	6 p. m	100	
18	9 a. m	99.5	
18	6 p. m	100	
19	9 a. m	100	
19	6 p. m	100	
20	9 a. m	99	
20	6 p. m	99.5	
21	9 a. m	100	
21	6 p. m	101	
22	9 a. m	100	
22	6 p. m	100.5	
23	9 a. m	100	
23	6 p. m	100.75	
24	9 a. m	101	
24	6 p. m	101	
25	9 a. m	100	
25	6 p. m	101	
26	9 a. m	101	
26	6 p. m	101	
27	9 a. m	101	
27	6 p. m	101.75	
28	9 a. m	100	
28	6 p. m	100	
29	9 a. m	100	
29	6 p. m	100.25	
30	9 a. m	100	
30	6 p. m	101	
31	9 a. m	99.5	
31	6 p. m	100	
Nov. 1	9 a. m	99	
1	6 p. m	100	
2	9 a. m	99	
2	6 p. m	100	
3	9 a. m	99.5	
3	6 p. m	100.5	
4	9 a. m	100	
4	6 p. m	101	Ravenous.
5	9 a. m	100	
5	6 p. m	100.5	
6	9 a. m	100	
6	6 p. m	100	
7	9 a. m	99.5	
7	6 p. m	100	
8	9 a. m	100	
8	6 p. m	100.5	
9	9 a. m	100.5	
9	6 p. m	101	
10	9 a. m	100	
10	6 p. m	100.5	
11	9 a. m	99.5	Costive.
11	6 p. m	100	
12	9 a. m	99	
12	6 p. m	100	
13	9 a. m	98.5	
13	6 p. m	99.75	
14	9 a. m	98	Medicine has opened bowels.
14	6 p. m	98	
15	9 a. m	97	
15	6 p. m	98	
16	9 a. m	95	
16	6 p. m	95	
17	9 a. m	95	
17	6 p. m	98	
18	9 a. m	95	Very cold. Feeds very poorly.

LARGE BERKSHIRE PIG NO. 2—Continued.

Date.	Time.	Body temperature.	Remarks.
1880.		° *F.*	
Nov. 18	6 p. m	98	
19	9 a. m	95	
19	6 p. m	95	
20	9 a. m		
20	6 p. m		
21	9 a. m		
21	6 p. m		
22	9 a. m		
22	6 p. m		
23	9 a. m		
23	6 p. m		
24	Noon		Found dead.

LARGE BERKSHIRE PIG, NO. 2.

Before his death, on the morning of November 24, this pig manifested symptoms of acute delirium, screaming in the most violent manner when approached, and attempting to bite. The eyes were congested and the muscular control very imperfect, the animal lying on its side and struggling.

The body is well nourished and the subcutaneous fat is in many places one inch to one inch and a half thick.

The *skin* has dark brown spots of the usual exudate, but no well marked purple patches. The tips of the ears are stiff, as if they had been bloodless and frozen before death.

Tongue and *pharynx* natural; the latter contains some white, tenacious, stringy mucus.

Guttural lymphatic glands moderately pigmented, and of a darkish gray.

Lungs healthy. The right lung is the seat of hypostatic congestion, evidently *post-mortem.*

Heart normal.

Stomach full, with its contents baked and closely adherent to the mucous membrane as if the organ had been inactive and digestion suspended for some time. The acidity of the contents is strongly marked. The gastric mucous membrane has bright red spots from one to two lines in diameter, especially on the great curvature and near the pylorus, but no distinct abrasions or ulcers.

Small intestines empty; slightly congested; what little ingesta is present is abnormally dry and adherent to the mucous membrane. At the commencement of the duodenum is a dark green mass of biliary matter, solid in consistency, but not dry.

Large intestines: Cæcum filled with hard, round pellets, firmly adherent to the mucous membrane, which is black on the surface, but not thickened, corrugated, nor ulcerated.

Colon in its anterior part has its contents somewhat softer and more natural. These are not formed into balls. Evidently this viscus has been recently functionally active, while the cæcum has been quite torpid or struck with atony.

The terminal part of the colon and the rectum have firmer contents formed into balls, but not firmly adherent to the mucous membrane as in the cæcum. Spots of congestion appear along the whole length of the large intestine, but no thickening, corrugation, ulceration, nor other sign of long-continued disease.

The mesenteric and sublumbar lymphatic glands are of a pale brownish yellow hue, neither enlarged nor visibly pigmented.

Liver soft, rather friable, and of a dark purple brown.

The gall-bladder is full of a liquid bile of a dark green color.

Spleen full, well developed, and not excessively gorged with blood.

Kidneys normal.

Brain: Coverings deeply congested, especially at the base, but with little or no exudation. The gray matter of the brain seems abnormally red, and the puncta vasculosa are numerous and well marked. No indication of softening could be detected.

REMARKS.

Although this pig finally died of phrenites, its case is one of deep interest in conection with the swine plague. It had contracted the plague before coming into my possession, and was already recovering when sent to me. For five months and a half I kept it exposed to the contagion of hog cholera, first by a cohabitation for six weeks with a sick and dying pig, then by continual confinement in the infected pen, and finally by four successive inoculations with the most potent virus I could obtain. Counting an exposure of a fortnight in the original diseased herd before he came into my hands, this pig was constantly exposed to the infection in a concentrated form for a period of six months. Of the inoculations in the course of this experiment, the two first were of a large and therefore specially dangerous amount of the virulent fluid injected under the skin; the third was a similar injection of the liquid virus which had been cultivated in wheat bran—a cultivation which, in my former experiments upon unprotected pigs, has always acted with deadly effect; and the fourth and last inoculation was with a slightly septic liquid, so that the pig was subjected to the risk of septicæmia as well as the genuine swine plague.

Chauveau has shown, as already stated, that in the related bacteridian disease, *anthrax*, while an animal can be protected by a first attack against the effects of an ordinary exposure to infection, and against inoculation with small quantities of the virus, that this immunity does not usually stand the test of a subcutaneous injection with a large amount of the liquid virus. Chauveau's experiments are so conclusive that they may be quoted:

> 1st. In a first series of experiments he made several small punctures on the inside of the ear with the point of a lancet charged with the virus. In this manner but a minimum quantity of virus was introduced. Six robust European sheep inoculated in this way all perished, whereas seven Algerian sheep showed not the slightest ill results from the operation.
>
> 2d. A second lot of four Algerian sheep were inoculated in the ear by a lancet charged with the fresh pulp of glands extremely rich in bacteria, and at the same time by injection under the skin of the thigh of a cultivated liquid rich in the *bacillus anthracis*. Three days later they were again inoculated by the hypodermic injection of five or six drops of a similar infecting cultivation liquid. Three of those subjects became distinctly though slightly ill. The fourth, a pregnant ewe, died early on the seventh day after the first inoculation.
>
> 3d. The third lot consisted of eight sheep (four ewes and their lambs). They were inoculated with a cultivation liquid very rich in the spores and mycelium of *bacillus anthracis*, to which was added the liquid extracted from diseased lymphatic glands, and literally saturated with bacillus rods. It was injected under the skin of the ears in doses of five or six drops for the ewes and three or four for the lambs. One lamb showed no symptom of illness, but all the others suffered considerably, and one ewe died of anthrax eight days after the inoculation.
>
> 4th. A fourth lot, eight animals, were each inoculated by injecting under the skin a cubic centimeter of a cultivation liquid rich in anthrax spores, mixed with gland juices rich in anthrax bacilli, and the remaining eight with half the amount of the same fluid. Of these, six died of anthrax, but only one of the six belonged to the eight that had been inoculated with the small dose. The others suffered from slight dullness and inappetense, but this speedily passed, and all were fully restored to health by the sixth day.
>
> 5th. At the same time that the second lot were subjected to experiment, Chauveau submitted to the same test the seven survivors of the first experiment. It caused a slight indisposition only. A third time he inoculated these seven in the same way as the third lot, and produced again but slight illness.

This shows conclusively that animals which are proof against an ordinary dose of the anthrax poison are still unable to resist a much larger dose or a succession of large doses. If we add to this that in chicken cholera (and the bacteridian diseases) Pasteur has found that the dilution of the virus can be so conducted as to produce a mild in place of a fatal form of the affection, it is altogether reasonable to suppose that in a third bacteridian disease, as swine plague is supposed to be, the same should hold equally true.

We may assume that this pig was fortified against a second attack of the disease by his first illness while with Mr. Frear, since a second attack, during the same season, at least, rarely occurs by reason of exposure to infection. In further proof of this we have the three inoculations with a large amount of virulent liquid, and a fourth with a more limited quantity, yet at no time did he show anything more than a slight indisposition, and he survived the last inoculation sixty-seven days, and finally died in fine condition from an accidental illness, for before death he showed mainly torpor of the liver and bowels, and finally, in connection with the sudden onset of extremely cold weather, congestion of the brain and delirium. The *post-mortem* appearances did not present the lesions of swine plague; the lymphatic glands were not enlarged nor pigmented (a very slight discoloration of the guttural excepted); the skin had none of the usual purple or leaden congestion, and the bowels showed no thickening, corrugation, erosions, nor ulcers. That the system had suffered from the action of the disease and the effects of the succession of test inoculations, added to the constant exposure in the infected pen, is strongly probable, and with the onset of winter the digestion became languid, the bowels torpid, and the final cold period which set in about November 15, and during which the temperature reached zero, brought about congestion of the brain and the fatal result.

We may assume from this case that the protection furnished by a first attack of hog cholera is relative and not absolute; that the system suffers permanently from such first attack, and even from successive exposures and inoculations, so that, although proof against any ordinary exposure to hog cholera, it is impaired in vigor, and for a time at least is more rather than less easily affected by other diseases; and, therefore, that animals so treated require increased protection against the weather or other health depressing conditions.

POLAND CHINA PIG, NO. 3.

This was a small unthrifty pig, the smallest of the litter, and the sole survivor, all the others having died of a disease supposed to have been hog cholera. It suffered besides from a nervous trouble and carried its head to one side and the neck partly twisted, so that one eye looked upward. It was also terribly infested with lice (*Hæmatopinus suis*).

Date.	Time.	Body temperature.	Remarks.
1880.		° *F.*	
June 26	9 a. m	102	Costive and eats little.
27	....do	102	Had dose castor oil.
28	....do	101.5	Had passage of hardened fæces.
29	....do	101.8	Castor oil repeated.
30	....do	100.8	No passage; took a third dose of castor oil.
July 1	....do	100.7	Bowels move freely.
2	....do	101	
3	....do	100	Purging; inoculated with a cultivation of virus in milk; second generation; kept seven days in a cool room.
4	....do	100	
4	6 p. m	100	
5	9 a. m	102	Bowels inactive.
5	6 p. m	99	Was roused from a deep sleep.
6	9 a. m	100	Bowels act freely.
6	6 p. m	101	
7	9 a. m	101	Purges.
7	6 p. m	101	Do.
8	9 a. m	101	Do.
9	....do	96	Do.
9	6 p. m	102.5	Do
10	9 a. m	98	Do
10	6 p. m	102	Do.
11	9 a. m	102	Do.
11	6 p. m	98	Do.

POLAND CHINA PIG, NO. 3—Continued.

Date.	Time.	Body temperature.	Remarks,
1880.		°F.	
July 12	9 a. m.	102.75	Purges.
13	....do	102	Do.
14	....do	99.75	Do.
15	6 p. m.	103	Do.
16	....do	99	Do.
17	9 a. m.	100.5	Do.
17	6 p. m.	99.5	Do.
18	9 a. m.	100	Dying; breathing in gasps.
18	Noon	....	Dead.

POST-MORTEM EXAMINATION, JULY 19, 1880.

The day being cold the body was left till next day (Monday), at which time it showed few traces of decomposition. The body was considerably emaciated, the skin thin and bloodless, without observable petechiæ, and with little of the black exudation. Blood dropped from the nostrils. There was no swelling or slough in the seat of inoculation.

The *blood* formed a loose clot.

The *inguinal glands* were small and nearly natural.

The *prethoracic* and *guttural lymphatic glands* were pigmented of a dark gray color.

The *right lung* was deeply reddened and gorged with blood, evidently a hypostatic congestion, and mostly post-mortem.

The *left lung* natural.

The *aortic lymphatic glands* were congested of a very deep red.

Stomach: The mucous membrane on the great curvature was of a deep red, with several black spots on blood extravasation, from one-half to one line in diameter, on the margins of the fold.

Spleen and *liver* seemed normal.

Intestines: Slightly congested. No ulcers were detected.

The *mesenteric glands* were enlarged, and, like the aortic, of a deep red color.

REMARKS.

The death of this pig serves to corroborate the conclusions deduced from the results in No. 1, that the introduction of new virus into a system at the time under the influence of swine-plague only serves to hasten a fatal result. It affords strong presumptive evidence that a first attack is only protection against a second, if the active effects of the first illness have completely subsided and convalescence completed.

LARGE WHITE PIG, NO. 4.

This pig was only four weeks old, it having been found difficult at the time to procure subjects of a more suitable age. Together with its fellow, it suffered seriously from the sudden change from the milk of its dam to other food, and from the complaint.

Date.	Time.	Body temperature.	Remarks.
1880.		°F.	
June 27	9 a. m.	103	
28	....do	104	
29	....do	102	
30	....do	101.5	
July 1	....do	102	
2	....do	102	
3	....do	101.5	Inoculated with cultivation of virus in egg-albumen: second generation; had been seven days in the apparatus. See microscopic drawing, Fig. 5.

LARGE WHITE PIG, No. 4—Continued.

Date.	Time.	Body temperature.	Remarks.
1880.		°F.	
July 4	do	101	Bowels loose
4	6 p. m	101.5	Purging.
5	9 a. m	102	Do.
5	6 p. m	102.5	Do.
6	9 a. m	103.5	
6	6 p. m	101	
7	9 a. m	103	
7	6 p. m	103	
8	9 a. m	101.5	
9	do	102	
9	6 p. m	105	
10	9 a. m	103	Inoculated with peritoneal exudation from Nort Carolina; kept in vacuum tube for eight day See microscopic drawing, Fig. 6.
10	6 p. m	105.4	
11	9 a. m	105.4	
11	6 p. m	105	
12	9 a. m	103.5	
13	do	103	
14	do	102.75	
15	do	104.3	
16	do	104	
17	do	100	Fæces fœtid.
17	6 p. m	102	
18	9 a. m	101.75	
18	6 p. m	102.75	
19	9 a. m	102	
19	6 p. m	104	
21	9 a. m	102	
22	do	104	
22	6 p. m	102	
23	9 a. m	102	
23	6 p. m	103.75	
24	9 a. m	103.5	
24	6 p. m	104	
25	9 a. m	101.75	Anus tender; thermometer perhaps not lon enough inserted.
25	6 p. m	104.5	
26	9 a. m	102	Rectum irritable and contracted.
26	6 p. m	103.5	Do.
27	9 a. m	102.5	Do.
27	6 p. m	104	Do.
28	9 a. m	102	Skin and bristles harsh.
28	6 p. m	103	
29	9 a. m	101.75	
29	6 p. m	103.5	
30	9 a. m	102	
30	6 p. m	104	Skin harsh, itchy.
Aug. 1	9 a. m	101	
1	6 p. m	105	
2	9 a. m	103	
2	6 p. m	102.75	Weather very cold.
3	9 a. m	101	Cold and wet.
3	6 p. m	101.5	Do.
4	9 a. m	101	Do.
4	6 p. m	103	Do.
5	9 a. m	100	
5	6 p. m	102.5	
6	9 a. m	101	
6	6 p. m	104.75	
7	9 a. m	99.5	
7	6 p. m	104	
8	9 a. m	100.5	
8	6 p. m	104.75	
9	9 a. m	103.5	
9	6 p. m	104.75	
10	9 a. m	100	
10	6 p. m	104.75	Placed in pen with convalescent pig, No. 2.
11	9 a. m	103.5	
11	6 p. m	104	
12	9 a. m	101.75	
12	6 p. m	103.75	Returned to its former pen.
13	9 a. m	101	Inoculated with dried virus, sent on quill fro North Carolina, July 2.
13	6 p. m	104	
14	9 a. m	101	
14	6 p. m	104	
15	9 a. m	100	Weather cold, showery; slight swelling whe last inoculated.

LARGE WHITE PIG, No. 4—Continued.

Date.	Time.	Body temperature.	Remarks.
1880.		° *F.*	
Aug. 15	6 p. m	102.5	
16	9 a. m	100	Cold, dry.
16	6 p. m	102.5	
17	9 a. m	101	
17	6 p. m	104.5	Cold.
18	9 a. m	102.5	
18	6 p. m	104	
19	9 a. m	103.5	Wet, warm.
19	6 p. m	103.75	
20	9 a. m	101	Warm, wet.
20	6 p. m	103.5	
21	9 a. m	103	Warm, muggy.
21	6 p. m	103.75	
22	9 a. m	101.75	
22	6 p. m	103.75	
23	9 a. m	102	
23	6 p. m	104.75	
24	9 a. m	102.75	
24	6 p. m	104	
25	9 a. m	101	
25	6 p. m	101	
26	9 a. m	101	
26	6 p. m	103	
27	9 a. m	101.5	
27	6 p. m	103.75	
28	9 a. m	101	
28	6 p. m	102	
29	9 a. m	101.5	
20	6 p. m	102.5	
30	9 a. m	101	Cold, wet.
30	6 p. m	102	
31	9 a. m	101	
31	6 p. m	102	
Sept. 2	9 a. m	101	
2	6 p. m	103	
3	9 a. m	102	
3	6 p. m	104	Inoculated with matter from North Carolina, that had been cultivated three days in wheat bran.
4	9 a. m	102.5	
4	6 p. m	104.75	
5	9 a. m	102.5	
5	6 p. m	104	
6	9 a. m	102.75	
6	6 p. m	104	
7	9 a. m	102.5	
7	6 p. m	103.75	
8	9 a. m	102	
8	6 p. m	104	
9	9 a. m	102.25	
9	6 p. m	103.75	
10	9 a. m	102	
10	6 p. m	104	
18	....do	103	Inoculated with virus from New Jersey, sent in liquid form and slightly putrid.
19	9 a. m	102	
19	6 p. m	103.5	
20	9 a. m	101.5	
20	6 p. m	102.75	
21	9 a. m	101.5	
21	6 p. m	102.5	
22	9 a. m	101	
22	6 p. m	102	
23	9 a. m	101	
23	6 p. m	102.5	
24	9 a. m	100	
24	6 p. m	101	
25	9 a. m	101	
25	6 p. m	102	
26	9 a. m	100	
26	6 p. m	101	
27	9 a. m	100.5	
27	6 p. m	101	
28	9 a. m	100	
28	6 p. m	99	Will not rise; has convulsive jerkings.
29	....	....	Found dead this morning.

POST-MORTEM EXAMINATION.

Dissection made on the forenoon of September 29.

Condition of body:—Emaciated, skin thin, bloodless, deficient in subcutaneous fat, and covered with much dark scurf. Dark purple blotches appear on the ears, submaxillary space, neck, breast, abdomen, and inner sides of the limbs. Pressure causes the momentary disappearance of each plaque, but leaves a number of ineffaceable purple points. There are hard subcutaneous swellings in the seat of the successive inoculations. One of these in the right flank has an outer layer of a dark blue fibroid appearance, within which is a firm layer of a dirty yellow aspect, and in the center a brownish-white creamy liquid. The latter appears to have resulted from the breaking down of the primary hard induration, while the inner yellow layer of the wall is in progress towards such disintegration. The liquid, when placed under the microscope with a magnifying power of 250 diameters, shows the object figured in microscopic drawing, Fig. 7, none of them magnifying automatic movements.

The *lymphatic glands*, *superficial*, *inguinal*, and *pharyngeal*, were of a deep red; the *internal*, *inguinal*, and *sublumbar* pigmented of a dark gray.

The *tonsils* contain yellowish cheesy products distending their follicles.

The *lungs* are natural, the *kidneys* sound; *spleen* normal.

The *liver* has, at intervals, purple plaques and patches. The *bile* is glutinous, of a dark orange-green color. The *common bile duct* is blocked by a large worm (*Ascaris suilla*), twelve inches long and bent upon itself. The bile duct leading into the right lobe contains a smaller *ascaris*.

Stomach:—The mucous membrane on the great curvature is of a deep brownish-red, more or less mottled. At intervals are minute depressions as if from dilated glands or loss of substance. Close in front of the pylorus are several ulcers, with bright yellow base and ragged non-projecting edges, surrounded by a pink areola. These are mostly under a line in diameter, but one has an extent of an inch and a half by one-sixth of an inch, evidently caused by the confluence of several smaller ones.

The *small intestines* and *mesentery* are deeply congested throughout. The *ilium* is filled with dark liquid blood, and its mucous membrane is much thickened and softened. (See Plate I.) A portion of the ilium is greatly distended by *ascarides*, and an adjacent portion has become invaginated to the extent of two inches into the end of the dilated portion, completely blocking its channel. (See Plate II.)

The *large intestines* are congested, and at intervals blood has been effused into their lumen.

The bowels contain twenty-four *ascarides*, varying in length from nine inches to a foot. The cæcum and colon contain a few whip-worms (*Tricocephalus dispar*).

REMARKS.

This pig had a specially hard experience, having been removed from its dam at an early age and at once subjected to a new, unwonted diet, and the action of the swine plague. As judged by the final result, it appears to show that the virus, as modified by cultivation in egg albumen, is no protection against a subsequent inoculation with a large amount of the native virus, or that which has had its potency increased by cultivation in wheat bran. Yet the early results were quite encouraging. The subject successfully resisted an inoculation with the virulent peritoneal exudate, though made only seven days after the first with a cultivation in egg albumen; also exposure to an infected pen, and inoculated from a quill smeared with the dried virus, and only perished forty-six days after, and when it had been reinoculated two more times with a drachm of a cultivation of the virus in bran, and two weeks later with a drachm of slightly putrid virus from a bad case of the plague. The question of using this septic virus was a delicate one, but considering that I could rarely secure fresh virus from sources outside my own experiments, and as hogs kept in the usual way must be constantly subjected to the risk of septic infection from sores on their bodies, I decided to put this to the test. The fatal result arrived after the use of three large injections of virulent matter, which I have since learned are often sufficient to overcome the power of resistance acquired from a first attack, and which are therefore to be avoided in future experiments. Another important point is that in this case the direct cause of death was the invagination of the intestine, and as this was a mere accidental result of the irritation of the bowels, it is possible that but for this the patient might have survived even the later and more severe inoculations.

SMALL WHITE PIG, No. 5.

This pig was from the same litter with No. 4, and had all its disadvantages, together with the fact of its smaller size and somewhat less thrift.

Date.	Time.	Body temperature.	Remarks.
1880.		°F.	
June 27	9 a. m	102.5	Lively, well.
28	do.	103	
29	do.	102	
30	do.	103	
July 1	do.	102	
2	do.	101	
3	do.	101.5	Inoculated with virus (lung exudate from sick pig at Horseheads) cultivated in human urine to second generation. Has been in apparatus 7 days. (See Microscopic Drawings, Fig. 8.)
4	do.	103	
4	6 p. m	103	Purges.
5	9 a. m	102	Do.
5	6 p. m	103	Do.
6	9 a. m	103.5	Do.
6	6 p. m	104	Do.
7	9 a. m	103.7	Do.
7	6 p. m	103.5	
8	9 a. m	102	
9	do.	102	
9	6 p. m	104.5	
10	9 a. m	103	Inoculated hypodermically ½ drachm peritoneal exudate of sick pig, kept 8 days in a vacuum tube, and sent from North Carolina. (See Microscopic Drawings, Fig. 6.)
10	6 p. m	104.9	
11	9 a. m	104.9	
11	6 p. m	103	
12	9 a. m	103.75	
13	do.	103	
14	do.	102.5	
15	6 p. m	103	
16	do.	102.5	
17	9 a. m	101.5	Skin covered with a black, greasy exudation, and itchy.
17	6 p. m	102.5	
18	9 a. m	103.5	
18	6 p. m	103	
19	9 a. m	101.75	
19	6 p. m	104	
21	9 a. m	100	
22	do.	104	
22	6 p. m	100	
23	9 a. m	102	
23	6 p. m	103	
24	9 a. m	101.25	
24	6 p. m	104	
25	9 a. m	103	
25	6 p. m	104.5	
26	9 a. m	101.5	
26	6 p. m	104	
27	9 a. m	101.5	
27	6 p. m	104	
28	9 a. m	103	Rectum has been irritable and contracted for several days.
28	6 p. m	104	Skin covered with a black exudation; bristles harsh.
29	9 a. m	102.75	
29	6 p. m	102.5	
30	9 a. m	102	
30	6 p. m	102.5	
31	9 a. m	101.25	
31	6 p. m	103	
Aug. 1	9 a. m	101	
1	6 p. m	104	
2	9 a. m	102	

Small White Pig, No. 5—Continued.

Date.	Time.	Body temperature.	Remarks.
1880.		° F.	
Aug. 2	6 p. m	103	Set in cold.
3	9 a. m	101	Cold and wet.
3	6 p. m	101.5	Do.
4	9 a. m	101	Do.
4	6 p. m	102.5	Do.
5	9 a. m	100	
5	6 p. m	102.5	
6	9 a. m	102	
6	6 p. m	104.75	
7	9 a. m	99.5	
7	6 p. m	104	
8	9 a. m	101	
8	6 p. m	104.25	
9	9 a. m	103	
9	6 p. m	104.5	
10	9 a. m	100.5	
10	6 p. m	104.5	Placed in infected pen with No. 2
11	9 a. m	103.5	
11	6 p. m	103.5	
12	9 a. m	103.25	
12	6 p. m	103.75	Returned to its former pen.
13	9 a. m	100	Inoculated with dried virus on quill sent fr North Carolina, July 2. Also, with 1 drach of infusion of decomposing maize, the latt hypodermically.
13	6 p. m	103.75	
14	9 a. m	102.5	
14	6 p. m	103.75	
15	9 a. m	102	Weather cold, showery. Swelling an inch diameter where inoculated with the corn sol tion.
15	6 p. m	102	
16	9 a. m	100	Cold, dry.
16	6 p. m	103.5	
17	9 a. m	99	Cold.
17	6 p. m	102.75	
18	9 a. m	103	Cold, threatening.
18	6 p. m	102.5	
19	9 a. m	103	
19	6 p. m	103.75	
20	9 a. m	102	Warm, wet.
20	6 p. m	103.5	
21	9 a. m	103	Muggy, warm.
21	6 p. m	103.75	
22	9 a. m	101.5	Clear.
22	6 p. m	104	
23	9 a. m	102	
23	6 p. m	104.25	Hot.
24	9 a. m	103.5	
24	6 p. m	104	
25	9 a. m	101	
25	6 p. m	101.75	
26	9 a. m	101	
26	6 p. m	102	
27	9 a. m	101.5	
27	6 p. m	103.5	
28	9 a. m	102	
28	6 p. m	103	
29	9 a. m	101	
29	6 p. m	102.5	
30	9 a. m	101	Cold, wet
30	6 p. m	102.5	
31	9 a. m	101	
31	6 p. m	102.25	
Sept. 2	9 a. m	101	
2	6 p. m	103	
3	9 a. m	102.5	Inoculated with virus cultivation in wheat-bra 1 drachm of infusion injected under the ski
3	6 p. m	104	
4	9 a. m	102	
4	6 p. m	104.5	
5	9 a. m	102	
5	6 p. m	103.25	
6	9 a. m	102	
6	6 p. m	103.75	
7	9 a. m	101.5	
7	6 p. m	103.5	
8	9 a. m	102	
8	6 p. m	103.75	

SMALL WHITE PIG, NO. 5—Continued.

Date.	Time.	Body temperature.	Remarks.
1880.		° *F.*	
Sept. 9	9 a. m	101	
9	6 p. m	103.5	
10	9 a. m	101.75	
10	6 p. m	103	
18	....do	102	Inoculated with virulent peritoneal exudation slightly putrid. One drachm injected under the skin.
19	9 a. m	101	
19	6 p. m	102.25	
20	9 a. m	101.5	
20	6 p. m	102	
21	9 a. m	101.75	
21	6 p. m	103	
22	9 a. m	101.5	
22	6 p. m	102	
23	9 a. m	101.5	
23	6 p. m	102.5	
24	9 a. m	100	
24	6 p. m	101	
25	9 a. m	101	
25	6 p. m	101	
26	9 a. m	100	
26	6 p. m	101	
27	9 a. m	101	
27	6 p. m	101.5	
28	9 a. m	101	
28	6 p. m	102	
29	9 a. m	101	
29	6 p. m	101.5	
30	9 a. m	99	
30	6 p. m	100	
Oct. 1	9 a. m	98	
1	6 p. m	99	
2			Died this morning.

POST-MORTEM EXAMINATION, OCTOBER 2—AFTERNOON.

Body badly emaciated, skin thin and bloodless, bluish discoloration beneath the breast-bone and on the hocks.

Inguinal lymphatic glands enlarged (especially the eighth) and pigmented. *Sublumbar lymphatic glands* not much affected. *Guttural lymphatic glands* congested and of a deep red. *Parotid lymphatic gland* pigmented gray. Abscess in the right flank in the seat of the last inoculation, with fetid contents.

Thyroid body enlarged.

Left lung has congested lobulettes of a dark red (almost black) color. The anterior lobe is carnified.

Right lung has the anterior lobe consolidated, and a section shows a deep red surface studded with white points.

Miliary tubercle. (See Plate III, Fig. 1.)

Liver large, black, very soft and friable.

Spleen normal.

Stomach contains a fair amount of ingesta and the mucous membrane covering the great curvature presents considerable thickening with dark brown discoloration. (See Plate III, Fig. 2.)

Small intestine is almost empty, but little altered.

Cæcum has its mucous membrane thickened, corrugated, and of a greenish black color, with red points at intervals. It contains many whipworms (*Tricocephalus dispar*) with their heads burrowed in the mucous membrane.

The *kidneys* are normal.

REMARKS.

This pig, though originally young and weak, and though subjected to a severe change of regimen at the commencement of the experiments, survived three successive inoculations and only succumbed in the end under the excessive hypodermic injections of infusion of virulent wheat bran and of slightly putrid virus. It failed in flesh from the first, a fact which may be largely accounted for by the pulmonary tuberculosis found after death. At the same time it is not impossible that this was a recent development from the last inoculation with semi-putrid matter, as happened repeatedly to Burdon-Sanderson in his experiments on Septicæmia.

The case seems to show that while a cultivation of the virus in acid urine may protect against a moderate exposure to infection, it is powerless to prevent untoward results in case of large injections of specially virulent matter, and above all if to such matter the septic poison is added.

BERKSHIRE PIG No. 6.

Date.	Time.	Body temperature.	Remarks.
1880.		°F.	
July 10	10 a. m		Inoculated with virulent peritoneal exudation of sick pig, sent from North Carolina, in a vacuum tube which has been open 36 hours. Strong odor of hog, but not putrid.
10	7 p. m	105.2	
11	9 a. m	105.2	
11	6 p. m	103	
12	9 a. m	102.75	
13	....do	103	
14	....do	101.5	
15	6 p. m	104.2	Swelling in seat of inoculation.
16	....do	105	
17	9 a. m	101.5	Purges. Dejection fœted.
17	6 p. m	101	
18	9 a. m	102	
18	6 p. m	103.5	
19	9 a. m	102.75	
19	6 p. m	103.5	
21	9 a. m	102	
22	....do	103.5	
22	6 p. m	102	
23	9 a. m	102	
23	6 p. m	102.75	
24	9 a. m	101	
24	6 p. m	103	
25	9 a. m	103	
25	6 p. m	103	Rectum irritable, contracted.
26	9 a. m	101	
26	6 p. m	102	Rectum irritable, contracted.
27	9 a. m	102.5	
27	6 p. m	105	Rectum irritable, contracted.
28	9 a. m	102	Do.
28	6 p. m	102.25	Do.
29	9 a. m	102	Do.
29	6 p. m	104	Do.
30	9 a. m	102.75	
30	6 p. m	103.25	
31	9 a. m	101.75	
31	6 p. m	104	
Aug. 1	9 a. m	100.5	
1	6 p. m	104.25	
2	9 a. m	102	
2	6 p. m	103	Set in cold weather.
3	9 a. m	102.25	Cold and wet.
3	6 p. m	101.5	Do.
4	9 a. m	101	Do.
4	6 p. m	103	Do.
5	9 a. m	101	
5	6 p. m	102.5	
6	9 a. m	101.5	Inoculated with cultivation of the virus in milk which was seeded with the virus July 29, and has stood in a cold room. One drachm injected.
6	6 p. m	103.5	
7	9 a. m	101	Swelling in seat of inoculation.
7	6 p. m	103	
8	9 a. m	101	
8	6 p. m	104	
9	9 a. m	102	
9	6 p. m	104	
10	9 a. m	99.5	
10	6 p. m	104	
11	9 a. m	101	
11	6 p. m	103	

Berkshire Pig, No. 6—Continued.

Date.	Time.	Body temperature.	Remarks.
1880.		°F.	
Aug. 12	9 a. m	101	
12	6 p. m	103.5	Placed in infected pen with No. 2.
13	9 a. m	101	Removed to old pen.
13	6 p. m	104	
14	9 a. m	101	
14	6 p. m	103	
15	9 a. m	101.5	
15	6 p. m	102.5	Cold, showery.
16	9 a. m	101.75	Cold, dry.
16	6 p. m	103.5	
17	9 a. m	102.5	Cold.
17	6 p. m	102.75	
18	9 a. m	101.25	Cold, threatening.
18	6 p. m	102.75	
19	9 a. m	102.5	Warm, rain.
19	6 p. m	103	
20	9 a. m	101	Warm, rain. Coughs.
20	6 p. m	101	
21	9 a. m	103.5	Muggy.
21	6 p. m	102	
22	9 a. m	102.5	Clear.
22	6 p. m	103.5	
23	9 a. m	102.5	
23	6 p. m	104	Hot.
24	9 a. m	101	
24	6 p. m	104.5	Hot.
25	9 a. m	102	
25	6 p. m	102.25	
26	9 a. m	101.75	
26	6 p. m	103	
27	9 a. m	101.5	
27	6 p. m	103	
28	9 a. m	101.75	
28	6 p. m	103	
29	9 a. m	101.75	
29	6 p. m	103	
30	9 a. m	101.5	Cold, wet.
30	6 p. m	102.5	
31	9 a. m	101.5	
31	6 p. m	103	
Sept. 2	9 a. m	101.25	
2	6 p. m	102.75	
3	9 a. m	102	Inoculated by hypodermic injection of one drachm of infusion of bran, inoculated with virus three days before.
3	6 p. m	104.5	
4	9 a. m	102.5	
4	6 p. m	104.75	Hot.
5	9 a. m	102	Thunderstorm.
5	6 p. m	103	Cooler.
6	9 a. m	102	
6	6 p. m	103.5	
7	9 a. m	102.25	
7	6 p. m	103	
8	9 a. m	102	
8	6 p. m	103.5	
9	9 a. m	102.25	
9	6 p. m	103.25	
10	9 a. m	102	
10	6 p. m	103	
18	....do	103	Has been very sick for the past week, but seems improving, though purging. Inoculated with virulent peritoneal exudation from sick pig in New Jersey, sent as a liquid and slightly putrid.
19	9 a. m	102	
19	6 p. m	103	
20	9 a. m	102.5	
20	6 p. m	103.5	
21	9 a. m	102.5	Dull. Skin very unthrifty; scurfy.
21	6 p. m	103.75	Is stiff behind and very lame in the near hind leg.
22	9 a. m	102.25	
22	6 p. m	103.75	
23	9 a. m	102	
23	6 p. m	102.5	
24	9 a. m	102	
24	6 p. m	103	
25	9 a. m	101	Very dull. Crouches with back raised, scours, fæces liquid with solid floating particles. Rectum irritable, contracted.

BERKSHIRE PIG, No. 6—Continued.

Date.	Time.	Body temperature.	Remarks.
1880.		°*F*.	
Sept. 25	6 p. m.	102.5	
26	9 a. m.	101	
26	6 p. m.	102	
27	9 a. m.	101.5	
27	6 p. m.	103	
28	9 a. m.	101	
28	6 p. m.	102.5	
29	9 a. m.	102	Dull, crouches; rectum tender, purges.
29	6 p. m.	103.25	
30	9 a. m.	102	
30	6 p. m.	103	
Oct. 1	9 a. m.	102.5	
1	6 p. m.	103.25	
2	9 a. m.	102	
2	6 p. m.	103	
3	9 a. m.	102.5	
3	6 p. m.	103	
4	9 a. m.	102	Dull; purges.
4	6 p. m.	103	
5	9 a. m.	100	
5	6 p. m.	102	
6	9 a. m.	102	
6	6 p. m.	103	
7	9 a. m.	101	
7	6 p. m.	102	
8	9 a. m.	101	
8	6 p. m.	102	
9	9 a. m.	102	
9	6 p. m.	104	
10	9 a. m.	102	
10	6 p. m.	103.5	
11	9 a. m.	102.5	
11	6 p. m.	103	
12	9 a. m.	101	Purges.
12	6 p. m.	102.5	
13	9 a. m.	100	Does not rise. Ears cold and blue.
13	6 p. m.	101	
14	9 a. m.	99	
14	6 p. m.	100	
15	9 a. m.	99	
15	6 p. m.	100	
16	9 a. m.	99	
16	6 p. m.	100	
17	9 a. m.	100	
17	6 p. m.	101	
18	9 a. m.	98	
18	6 p. m.	98	
19	....	....	Found dead this morning. Still warm.

POST-MORTEM EXAMINATION, 3 P. M. SAME DAY.

Skin on the snout, lips, ears, forearm, thighs, and to a less extent on the abdomen, of a deep red, marked even on the black skin. These discolored portions are found on section to be of a dark red throughout the whole thickness, the result of a capillary engorgemet, stasis, and extravasation, as shown on microscopic examination. In the right flank, in the seat of inoculations, are two firm, rounded masses, each about ¾ inch in diameter, situated in the subcutaneous connective tissue, and consisting of a pus-like fluid, inclosed in thick fibroid walls. The liquid is not fœtid.

The superficial inguinal glands are greatly enlarged and of a deep red throughout.

The *tongue* has its papillæ enlarged, and on the margins near its anterior extremity spots slightly raised and abraded in the center.

The *guttural* and *prepectoral glands* are enlarged and congested, of a very dark red.

The *heart* on the right side contains a firm clot, mostly buffy. That in the auricle and venæ cavæ may be said to be almost destitute of red globules.

The left side of the *heart* contains a similar but smaller clot. The septum ventriculorum on this side bears several dark red petechiæ,

Lungs normal.

Internal inguinal sublumbar and *mesenteric lymphatic glands* are enlarged and of a deep red color.

Kidneys and *spleen* normal.

Stomach contains a considerable amount of undigested food. The mucous membrane *is in a* natural condition.

Small intestine little altered; contains twelve large worms (*Ascaris suilla*).

Large intestine is slightly congested, with petechiæ and enlarged follicles.

Liver is variously colored. Parts are of a light brownish-yellow and parts of a dark purplish-red. All very friable. The gall bladder is partly filled with dark-green bile. The common bile duct is filled by a large *ascaris*, which projects into the duodenum and extends beyond the cystic duct into the biliary duct and liver. These distended ducts are somewhat red and congested.

REMARKS.

This pig was first employed as a test case of the virulence of the North Carolina virus sent in a vacuum tube. The inoculation with this material produced a moderate though distinct attack of swine plague, from which the animal recovered so that it ought to have been as well fortified against a second attack as if it had contracted the disease in the ordinary way. Four weeks after the first inoculation the patient was again inoculated, this time with milk, on which the virus had been sown and cultivated for eight days. Though a drachm of this liquid had been injected, there seemed to be little effect beyond the occurrence of a swelling in the seat of inoculation. Six days later it was placed over night in an infected pen along with a convalescent pig. These having proved apparently harmless, the patient was injected with a drachm of virulent liquid from an inoculated bran infusion. As in the case of other pigs, this produced a smart attack of the disease, but in two weeks it seemed improving and was again injected with ½ drachm of virulent and slightly putrid peritoneal exudation. From this time onward its illness was continuous, and it steadily sank, though it survived the last inoculation four weeks in all.

The case is interesting as showing the power of resistance of the convalescent animal to inoculation with a large amount of infected milk, and also to the confinement in an infected pen, but it is none the less so as corroborating the other cases in showing that this acquired insusceptibility was broken down before a large injection of virulent infusion of wheat bran, and of the same amount of peritoneal exudation of a bad case of hog cholera.

FEMALE BERKSHIRE PIG, No. 7.

Date.	Time.	Body temperature.	Remarks.
1880.		°F.	
July 27	6 p. m.	105	
28	9 a. m.	103.25	
28	6 p. m.	103	
29	9 a. m.	104	Inoculated with milk that had been charged with virus two days previous, but by accident had been raised to at least 120° F. See Microscopic Drawings, Fig. 9.
29	6 p. m.	103.75	
30	9 a. m.	104	
30	6 p. m.	104.5	
31	9 a. m.	103.75	
31	6 p. m.	103	
Aug. 1	9 a. m.	103	
1	6 p. m.	106	
2	9 a. m.	103	
2	6 p. m.	105	Set in cold.
3	9 a. m.	103	Cold and wet.
3	6 p. m.	103.25	Do.
4	9 a. m.	102.75	Do.
4	6 p. m.	103.5	Do.
5	9 a. m.	101	
5	6 p. m.	103	
6	9 a. m.	102.75	Inoculated with one drachm human urine that had been infected with virulent matter July 29.

FEMALE BERKSHIRE PIG, No. 7—Continued.

Date.	Time.	Body temperature.	Remarks.
1880.		° *F.*	
Aug. 6	6 p. m	103.25	
7	9 a. m	100.75	
7	6 p. m	103	
8	9 a. m	101.75	
8	6 p. m	105	
9	9 a. m	103	
9	6 p. m	104.5	
10	9 a. m	102.5	
10	6 p. m	104.5	
11	9 a. m	102.5	
11	6 p. m	103.75	
12	9 a. m	103	
12	6 p. m	104	
13	9 a. m	101.5	Before fed.
13	6 p. m	104	
14	9 a. m	103	
14	6 p. m	104	
15	9 a. m	100.75	Cold, showery.
15	6 p. m	103	
16	9 a. m	100.75	Cold, dry.
16	6 p. m	104.5	
17	9 a. m	100.5	Cold.
17	6 p. m	102.25	
18	9 a. m	101	
18	6 p. m	103.5	
19	9 a. m	101	
19	6 p. m	105	
20	9 a. m	103	Warm, wet.
20	6 p. m	102.5	
21	9 a. m	102.5	Muggy.
21	9 p. m	103	
22	9 a. m	101.75	Clear.
23	6 p. m	104	
23	9 a. m	102	
23	6 p. m	104.5	
24	9 a. m	101.75	
24	6 p. m	104.25	Hot.
25	9 a. m	101.5	
25	6 p. m	102.75	
26	9 a. m	102	
26	6 p. m	103.25	
27	9 a. m	102	
27	6 p. m	103.5	
28	9 a. m	101.5	
28	6 p. m	103.5	
29	9 a. m	101.75	
29	6 p. m	103.5	
30	9 a. m	102	Cold, wet.
30	6 p. m	103.5	
31	9 a. m	102	
31	6 p. m	103	
Sept. 2	9 a. m	102	
2	6 p. m	103.5	Hot.
3	9 a. m	103	
3	6 p. m	104.5	Do.
4	9 a. m	102.5	
4	6 p. m	104	Do.
5	9 a. m	102	
5	6 p. m	103	Cooler.
6	9 a. m	102.3	
6	6 p. m	104	
7	9 a. m	102.5	
7	6 p. m	103.75	
8	9 a. m	102.75	
8	6 p. m	104	
9	9 a. m	102.25	
9	6 p. m	103.75	
10	9 a. m	102	
10	6 p. m	103.75	
18	6 p. m	103.75	Inoculated with one drachm peritoneal exudation slightly putrid, from a sick pig at Camden, N. J.
19	9 a. m	103	
19	6 p. m	103.75	
20	9 a. m	102.75	
20	6 p. m	104	
21	9 a. m	102	
21	6 p. m	103.75	
22	9 a. m	102	
22	6 p. m	103	

FEMALE BERKSHIRE PIG, No. 7—Continued.

Date.	Time.	Body temperature.	Remarks.
1880.		° *F.*	
Sept. 23	9 a. m	103	
23	6 p. m	104.5	
24	9 a. m	102	
24	6 p. m	102.5	Cool.
25	9 a. m	103	
25	6 p. m	103.75	Day warm. Patient dull, sluggish; anus tender, contracted.
26	9 a. m	102.5	
26	6 p. m	102.75	
27	9 a. m	101	
27	6 p. m	102	
28	9 a. m	102	
28	6 p. m	103.5	
29	9 a. m	102	
29	6 p. m	102.5	
30	9 a. m	102	
30	6 p. m	103.75	
Oct. 1	9 a. m	103	
1	6 p. m	103.5	
2	9 a. m	102.75	Thirsty; feeds sparingly.
2	6 p. m	104	
3	9 a. m	103	
3	6 p. m	105.5	
4	9 a. m	102.5	
4	6 p. m	103	
5	9 a. m	102	
5	6 p. m	103	
6	9 a. m	102.5	
6	6 p. m	104.5	
7	9 a. m	102	
7	6 p. m	103	
8	9 a. m	103	Dull; careless of food.
8	6 p. m	105	
9	9 a. m	103	
9	6 p. m	104	Abscess in seat of inoculation open.
10	9 a. m	103	
10	6 p. m	104	Warm.
11	9 a. m	103	
11	6 p. m	104.5	
12	9 a. m	103.5	
12	6 p. m	103	
13	9 a. m	103	
13	6 p. m	104	Purges.
14	9 a. m	103	
14	6 p. m	104.5	
15	9 a. m	104.5	Dull, purges.
15	6 p. m	104.75	Do.
16	9 a. m	104	
16	6 p. m	105	Do.
17	9 a. m	102	
17	6 p. m	102.5	Do.
18	9 a. m	101	
18	6 p. m	102	Do. Very low.
19	9 a. m	99	
19	6 p. m	98	Very low.
20	9 a. m	98	Dull, purges.
20	6. p m	96	
21			Found dead this morning.

POST-MORTEM EXAMINATION, OCTOBER 21, 2 P. M.

Skin, snout, ears, throat, abdomen, inside of fore and hind legs and of thighs dark red or mottled, the discoloration extending through the whole thickness of the skin in such parts. There is engorgement, capillary stasis, and rupture. Subcutaneous fat is fairly abundant.

In the right flank are two abscesses with inspissated and almost caseous contents, marking the seats of inoculation.

The *external inguinal* and *guttural lymphatic glands* are enlarged and congested of a dark red.

On the right border of the *tongue*, at the base and near the middle, are two ulcers, each having a central yellow slough, and measuring about 3 lines by 2. Around the margin of each ulcer the tissues are of a dark red, almost black.

Lungs, sound.

Heart, right side, contains dark fluid blood.

Left side and *large arteries* inclose a clot of fibrine almost devoid of red globules.

The *left kidney* has a large cyst on its convex aspect filled with a limpid yellowish urine. This caused such an indentation that it gave the appearance of a hilus on the outer border as well as on the inner. The pelvis was also fully distended with urine, but no obstructing calculus was found. The organ showed some dark red plaques on its surface. The *right kidney* was large, but apparently healthy. The bladder was filled with a limpid yellowish urine.

The *liver* was a very dark purple and unnaturally friable; the bile dark green, thick, and tenacious.

The *stomach* had the mucous membrane covering the great curvature of a brownish red, with small black clots of extravasated blood on the summits of the mucous folds and even elsewhere, so that the surface had a maculated aspect.

The *small intestines* show patches of congestion at intervals.

The *cæcum* and *colon* have their mucous membrane congested, so that the cut surface appears dark and bloody like the black portions of the skin. No ulcers are found.

The *mesenteric lymphatic glands* are of a dark red, especially those belonging to the small intestines.

REMARKS.

In this case the inoculation in urine produced a certain amount of fibrile reaction, but this did not protect the system from the deadly effects of a hypodermic injection of a drachm of the slightly overkept virulent peritoneal exudation obtained from New Jersey. This case unfortunately was not subjected to simple exposure to infection to ascertain whether the inoculated urine would prove protective against that mainly because on the 18th September I was not sufficiently alive to the dangers of a great overdose of poison administered hypodermically.

FEMALE BERKSHIRE PIG, NO. 8.

Date.	Time.	Body temperature.	Remarks.
1880.		° F.	
July 27	6 p. m	105. 25	The high temperature caused by a chase.
28	9 a. m	102. 75	
28	6 p. m	103	
29	9 a. m	102. 5	Inoculated with infected milk that had been two days in incubator and accidently exposed to 120° F., or even more.
29	6 p. m	103. 25	
30	9 a. m	102. 5	
30	6 p. m	104	
31	9 a. m	103	
31	6 p. m	104	
Aug. 1	9 a. m	103	
1	6 p. m	105	
2	9 a. m	102. 5	
2	6 p. m	103. 5	Cold.
3	9 a. m	101. 75	Cold and wet.
3	6 p. m	103	Do.
4	9 a. m	102	Do.
4	6 p. m	101. 5	Do.
5	9 a. m	101. 75	
5	6 p. m	101. 5	
6	9 a. m	101. 75	Inoculated with milk infected July 29.
6	6 p. m	102. 75	
7	9 a. m	101. 5	
7	6 p. m	102. 5	
8	9 a. m	101. 75	
8	6 p. m	104. 75	
9	9 a. m	103	
9	6 p. m	104. 25	
10	9 a. m	102	
10	6 p. m	104. 25	
11	9 a. m	101. 5	
11	6 p. m	103	
12	9 a. m	102	
12	6 p. m	103	
13	9 a. m	101. 5	Inoculated with pus from inoculation swelling of No. 2. See microscopic drawings, Fig. 4.
13	6 p. m	103	
14	9 a. m	103	
14	6 p. m	101	

FEMALE BERKSHIRE PIG, No. 8—Continued.

Date.	Time.	Body temperature.	Remarks.
1880.		° F.	
Aug. 15	9 a. m	100	Cold, showery.
15	6 p. m	102	
16	9 a. m	99.7	
16	6 p. m	102.5	
17	9 a. m	100	Cold.
17	6 p. m	102.75	
18	9 a. m	101	Cold, threatening. A nodule like a bean where last inoculated.
18	6 p. m	102.5	
19	9 a. m	101	Warm, wet.
19	6 p. m	103.5	
20	9 a. m	102	Do.
20	6 p. m	101.5	
21	9 a. m	101.5	Muggy.
21	6 p. m	102	
22	9 a. m	102.75	
22	6 p. m	103.75	
23	9 a. m	102.5	
23	6 p. m	103.75	Hot.
24	9 a. m	101.75	
24	6 p. m	104.5	Do.
25	9 a. m	101	
25	6 p. m	102.25	
26	9 a. m	101	
26	6 p. m	102	
27	9 a. m	102	
27	6 p. m	104	
28	9 a. m	101.75	
28	6 p. m	103.75	
29	9 a. m	101.5	
29	6 p. m	103.5	
30	9 a. m	101.5	Cold, wet.
30	6 p. m	103	
31	9 a. m	101	
31	6 p. m	102	
Sept. 2	9 a. m	101	
2	6 p. m	103	
3	9 a. m	102	Inoculated with infusion of bran inoculated with virus from North Carolina and cultivated three days.
3	6 p. m	103.25	Hot.
4	9 a. m	102	
4	6 p. m	103.5	
5	9 a. m	101.5	
5	6 p. m	102.5	
6	9 a. m	101.5	
6	6 p. m	102	
7	9 a. m	102.75	
7	6 p. m	102.5	
8	9 a. m	101.75	
8	6 p. m	102.5	
9	9 a. m	102	
9	6 p. m	103	
10	9 a. m	102	
10	6 p. m	102.75	Has been sick during the past week.
18	6 p. m	103	Inoculated by injecting hypodermically one dram of virulent peritoneal exudation slightly septic, from sick pig, in New Jersey.
19	9 a. m	102.5	
19	6 p. m	103	
20	9 a. m	102	
20	6 p. m	103	
21	9 a. m	101.75	
21	6 p. m	102.75	
22	9 a. m	101.5	A diffuse swelling in the seat of inoculation.
22	6 p. m	102.5	
23	9 a. m	101	
23	6 p. m	102	Snuffles in breathing.
24	9 a. m	101	Snuffling breathing continued more or less to the end.
24	6 p. m	103	
25	9 a. m	102	
25	6 p. m	102.25	Skin scurfy and unhealthy, but bright, and has a good appetite.
26	9 a. m	101	
26	6 p. m	102	
27	9 a. m	101.5	
27	6 p. m	102	

FEMALE BERKSHIRE PIG, No. 8.—Continued.

Date.	Time.	Body temperature.	Remarks.
1880.		° *F.*	
Sept. 28	9 a. m	101	
28	6 p. m	102	
29	9 a. m	100	
29	6 p. m	101	
30	9 a. m	101	
30	6 p. m	102.75	
Oct. 1	9 a. m	101	
1	6 p. m	102.5	
2	9 a. m	101.25	
2	6 p. m	102.75	
3	9 a. m	101	
3	6 p. m	102.5	
4	9 a. m	101	
4	6 p. m	102.5	
5	9 a. m	100	
5	6 p. m	101	
6	9 a. m	100	
6	6 p. m	101.5	
7	9 a. m	100.75	
7	6 p. m	102.5	
8	9 a. m	101	
8	6 p. m	102	
9	9 a. m	101	
9	6 p. m	102	
10	9 a. m	101	
10	6 p. m	102.5	
11	9 a. m	101	
11	6 p. m	101.5	
12	9 a. m	100	
12	6 p. m	101.5	
13	9 a. m	101	
13	6 p. m	102.5	
14	9 a. m	100	
14	6 p. m	101.75	
15	9 a. m	102	
15	6 p. m	102.5	
16	9 a. m	102.5	
16	6 p. m	104	
17	9 a. m	100	
17	6 p. m	100	
18	9 a. m	99.5	
18	6 p. m	100	
19	9 a. m	98	
19	6 p. m	98	Has to be lifted to drink from this time onward.
20	9 a. m	99	
20	6 p. m	102	
21	9 a. m	100	
21	6 p. m	102	
22	9 a. m	101	Purges and is very weak.
22	6 p. m	102.5	Purging constant from this time.
23	9 a. m	101	
23	6 p. m	102.75	
24	9 a. m	104	
24	6 p. m	104	
25	9 a. m	103.25	
25	6 p. m	103.5	
26	9 a. m	103.25	
26	6 p. m	103.5	
27	9 a. m	101.5	
27	6 p. m	101.75	
28	9 a. m	101.5	
28	6 p. m	102.5	
29	9 a. m	102.75	
29	6 p. m	103.75	
30	9 a. m	102.5	
30	6 p. m	104.5	
31	9 a. m	104	
31	6 p. m	104.5	
Nov. 1	9 a. m	104	
1	6 p. m	104.25	
2	9 a. m	103	
2	6 p. m	104	
3	9 a. m	103.5	
3	6 p. m	104	
4	9 a. m	104	
4	6 p. m	104.5	
5	9 a. m	104	
5	6 p. m	104	
6	9 a. m	103	
6	*6 p. m*	103	

FEMALE BERKSHIRE PIG, No. 8.—Continued.

Date.	Time.	Body temperature.	Remarks.
1880.		° *F.*	
Nov. 7	9 a. m	103	
7	6 p. m	103	
8	9 a. m	102.5	
8	6 p. m	102.25	
9	9 a. m	102	
9	6 p. m	102	
10	9 a. m	101.5	
10	6 p. m	101	
11	9 a. m	92	The body is very much emaciated, the hind legs cold and rigid, and blue from the thighs downward. Snout blue. A frothy discharge flows from the nostrils.

The pig was now killed by bleeding. Very little blood flowed, but this was quite red, clotted firmly without buffy coat, and was long in showing signs of active putrefaction.

POST-MORTEM EXAMINATION.

A wound made six days ago on the back of the ear, to obtain a drop of blood, is still open and suppurating.

The *tongue* has a yellow fur on the dorsum. The *right tonsil* has enlarged follicles, with yellowish, cheesy, granular contents.

The *guttural lymphatic glands* enlarged and pigmented, of a dark gray color. The *prepectoral* and *subdorsal glands* are in the same condition.

The *lungs* are of a pale pink, with spots of blood-red extravasation, probably from the inhalation of blood in dying.

The *heart* is soft, flaccid, and pale, as if parboiled, and empty.

The *inguinal sublumbar* and *iliac lymphatic glands* are enlarged and pigmented. The *rectal lymphatic glands* are black.

The *mesenteric, gastric,* and *hepatic lymphatic glands* are of a dark gray, with patches of deep red.

The *bowels* show patches of congestion, but no abrasion nor ulcer is found.

The *kidneys* have their cortical part of a yellowish brown and friable, the medullary portion, and especially the papillæ, of a deep red.

The *liver* is of a deep red color with darker purple patches. It is gorged with blood and bleeds freely on section. The *bile* in the gall bladder is small in quantity and inspissated to the consistency of a tenacious semi-solid dark green mass.

Brain and *spinal cord:* Subarachnoid fluid in excess. The coverings of the brain are deeply congested, and the puncta vasculosa very numerous and large. The whole of the gray matter seems to have a slightly pink tinge.

The *internal* and *middle ear* on the left side is the seat of a deposit of a dark gray cheesy matter, the surface of the bone is in great part denuded of periostium, and ulceration has progressed to a considerable extent.

REMARKS.

The two first inoculations of this pig with the cultivation of the virus in the milk produced a very slight constitutional reaction. The subject appeared to resist an inoculation with a minimum amount of virus from No. 2, yet, like all its predecessors, it sickened under the influence of a large hypodermic injection of the virus as cultivated in bran, and succumbed to the hypodermic injection of a drachm of the peritoneal exudation from a sick pig in New Jersey. This test, as I have now learned, is far too severe, and out of all proportion to a simple exposure in an infected place, or cohabitation with diseased animals, yet the recent lesions in the skin, lymphatic glands, lungs, and bowels were so inconsiderable that it is not at all improbable this animal would have survived but for the accidental implication of the internal ear and the brain. These last accounted for the persistent snuffling breathing, the increasing lethargy and paralysis, and the utter inability to rally.

WHITE PIG, No. 9.

Date.	Time.	Body temperature.	Remarks.
1880.		° F.	
Aug. 23	6 p. m	104.5	Placed in infected pen with No. 2, and inoculated from dried virus on quill from North Carolina.
24	9 a. m	103	
24	6 p. m	104	
25	9 a. m	102	Scours.
25	6 p. m	103	Do.
26	9 a. m	101.5	Do.
26	6 p. m	102.75	Do.
27	9 a. m	102	Do.
27	6 p. m	104	Do.
28	9 a. m	101.5	Do.
28	6 p. m	103	Do.
29	9 a. m	101	Do.
29	6 p. m	103.75	Do.
30	9 a. m	102	Do.
30	6 p. m	103.75	Scours; placed in infected pen with No. 6.
31	9 a. m	102	
31	6 p. m	104	
Sept. 1	9 a. m	102	
1	6 p. m	103.5	
2	9 a. m	102.5	Inoculated by hypodermic injection of 1 drachm virulent liquid cultivated in wheat bran for three days.
2	6 p. m	105	
3	9 a. m	103	Swelling one-half inch in diameter where inoculated.
3	6 p. m	104.75	
4	9 a. m	102.5	
4	6 p. m	103.75	
5	9 a. m	102	
5	6 p. m	103.5	
6	9 a. m	102	
6	6 p. m	103.5	
7	9 a. m	102.5	
7	6 p. m	103.5	
8	9 a. m	102.25	
8	6 p. m	103.75	
9	9 a. m	102.5	
9	6 p. m	104	
10	9 a. m	102.25	
10	6 p. m	103.75	
18	6 p. m	103.5	
19	9 a. m	102	
19	6 p. m	104	
20	9 a. m	102	
20	6 p. m	103.5	
21	9 a. m	101.75	
21	6 p. m	103.25	
22	9 a. m	101.5	
22	6 p. m	102.5	
23	9 a. m	101.5	
23	6 p. m	102.5	Tail and ears livid.
24	9 a. m	102.5	
24	6 p. m	103	
25	9 a. m	103.5	Day warm. Scours and is very dull.
25	6 p. m	103.2	Scours and is very dull.
26	9 a. m	103.5	Do.
26	6 p. m	104.75	Do.
27	9 a. m	104	Do.
27	6 p. m	104.75	
28	9 a. m	104	
28	6 p. m	104.5	Do.
29	9 a. m	103.75	Do.
29	6 p. m	105.5	Do.
30	9 a. m	103	Do.
30	6 p. m	103.75	Do.
Oct. 1	9 a. m	103	Do.
1	6 p. m	104	Do.
2	9 a. m	103.5	Do.
2	6 p. m	105.5	Do.
3	9 a. m	104	Do.
3	6 p. m	107	Do.
4	9 a. m	104.5	Scours. Fœtid part of tail separating.
4	6 p. m	107.5	Scours. Ears blue throughout.
5	9 a. m	104	Scours.
5	6 p. m	106	Scours. Inguinal glands enlarged.
6	9 a. m	104.5	Scours.
6	6 p. m	107	Do.

WHITE PIG, No. 9—Continued.

Date.	Time.	Body temperature.	Remarks.
1880.		° *F.*	
Oct. 7	9 a. m	103	Scours.
7	6 p. m	104.5	Do.
8	9 a. m	102	Scours. Weak; staggers; trembles.
8	6 p. m	102.5	Do.
9			Died to-day. Necropsy at once.

POST-MORTEM OBSERVATIONS, 4 P. M.

Body still warm. *Rigor mortis* setting in.

Skin: Snout has its upper third very dark red, lower two-thirds black. *Lower jaw* and intermaxillary space of a dark red. *Ears* of a dark bluish red, except at the base of the concha, where it is spotted, the dark red spots being unchanged by pressure. The *right eye* has a sore on the lower lid at the inner angle, two lines in length by one in breadth, presenting a dark scab or slough with white scaly margins and a dark red or livid areola. A smaller slough exists in the middle of the upper lid with white scaly crust. Apart from the sores the lids are pale, but the surrounding skin is of a dark bluish red. Both lids and conjunctiva of the left eye are of a deep bluish red, with a slough about a line in length on the mucous membrane inside the middle of the upper lid. The breast, sheath, and adjacent parts of the abdomen, the perineum, rump, tail, and insides of the fore and hind limbs are of a deep bluish red. Half of the tail is in a sloughing condition. No swelling remains in the seat of inoculation.

The *guttural* and *parotid lymphatic glands* are two or three times their natural size, and of a very deep red color.

The *tongue* has on its right margin three yellow ulcers, each from one line to one and a half lines, and becoming confluent. Another smaller ulcer is opposite the circumvallate papillæ.

The *prepectoral glands* are enlarged and of a very dark red.

The *bronchial lymphatic glands* are of a deep red, but not so dark.

The *right heart* and large veins contain large clots of a very dark color.

The *left heart* holds a smaller clot, also very dark.

Lungs: A wedge-shaped mass in the posterior portion of the *right lung* is hepatized and almost black, the hepatization being circumscribed by the lobulettes. The whole posterior portion of the *left lung* is solid from hepatization and almost black. The lower portion of the entire lung is of a deep dark red, and mostly carnified. (See Plate IV.)

The *superficial inguinal glands* are greatly enlarged and of a dark red.

A small abscess with fœtid puriform contents exists beneath the peritoneum on the right side near the seat of inoculation.

The *liver* is dark bluish red and friable. The *gall bladder* is full, but not over-distended, with dark green, thick, tenacious bile.

The *spleen* is blue mottled, normal in size and consistency.

Lower surface of both kidneys thickly studded with black petechiæ about the size of pins' heads. (See Plate V, Fig. 1.) On section the cortical substance appears of a yellowish brown, the medullary of a pink hue.

The sublumbar, emulgent, and rectal lymphatic glands are of a dark red hue; the mesenteric glands mottled, red, and dirty white.

The *stomach* has the mucous membrane of its greater curvature of a deep dark red, excepting on the summits of the rugæ, which are pale or pinkish yellow, according to the congestion. There are several sores with yellowish sloughs near the margin of the congested area. Also an extensive yellow fur like a diphtheritic membrane somewhat nearer to the pylorus. (See illustration, Plate V, Fig. 2.)

The *gastric lymphatic glands* are of a very deep red and considerably enlarged.

Both *small* and *large intestines* are congested at intervals. The *rectum* is congested, of a very deep red. The mucous membrane is softened and presents several spots, each from one to two lines in diameter, evidently due to extravasation of blood. (See Plate VI.) Peyer's patches on the ilio-cæcal valve has its follicles greatly enlarged and filled with a yellowish cheesy material. (See Plate VII, Fig. 1.)

SMALL WHITE PIG, No. 10.

Date.	Time.	Body temperature.	Remarks.
1880.		° *F.*	
Aug. 23	6 p. m	104.5	Inoculated with virus from North Carolina dried on a quill. Placed in infected pen with No. 2.
24	9 a. m	103	
24	6 p. m	104	
25	9 a. m	102	Scours.
25	6 p. m	103.5	Do.
26	9 a. m	101.5	Do.
26	6 p. m	103	Do.
27	9 a. m	102	Do.
27	6 p. m	104	Do.
28	9 a. m	102.75	Do.
28	6 p. m	104	Hot.
29	9 a. m	102	Hot.
29	6 p. m	103	Cool.
30	9 a. m	102	Cold, wet.
30	6 p. m	104	
31	9 a. m	102	
31	6 p. m	104	
Sept. 2	9 a. m	102.5	
2	6 p. m	103.75	
3	9 a. m	103	Inoculated by hypodermic injection of one-half drachm infusion of bran, infected three days before.
3	6 p. m	105	
4	9 a. m	103	
4	6 p. m	104	
5	9 a. m	102.5	
5	6 p. m	104	
6	9 a. m	102.5	
6	6 p. m	103.75	
7	9 a. m	102.75	
7	6 p. m	104	
8	9 a. m	103	
8	6 p. m	104.25	
9	9 a. m	103	
9	6 p. m	104	
10	9 a. m	102.25	
10	6 p. m	103.75	
18	6 p. m	104	Has been improving and looks hopeful. Inoculated with one-half drachm of virulent peritoneal exudation partly septic.
19	9 a. m	102	
19	6 p. m	103.5	
20	9 a. m	102	
20	6 p. m	103.75	Costive.
21	9 a. m	102	
21	6 p. m	103	
22	9 a. m	102	
22	6 p. m	103.5	
23	9 a. m	103	
23	6 p. m	104.75	Costive. Fæces have a mucous coating.
24	9 a. m	103	
24	6 p. m	104	Costive. Trembles at times.
25	9 a. m	103	Bowels easy without purging. Ears livid.
25	6 p. m	104.75	
26	9 a. m	103.5	
26	6 p. m	106	
27	9 a. m	103.5	
27	6 p. m	104.75	
28	9 a. m	104.5	
28	6 p. m	105.5	
29	9 a. m	104.5	
29	6 p. m	106	
30	9 a. m	104	
30	6 p. m	105.75	
Oct. 1	9 a. m	104	
1	6 p. m	105.75	
2	9 a. m	104.5	
2	6 p. m	106	
3	9 a. m	105	
3	6 p. m	103.25	
4	9 a. m	105	
4	6 p. m	106.5	Purges; very dull. Purple skin on ears, breast, abdomen, and legs.
5	9 a. m	104	
5	6 p. m	105	
6	9 a. m	104	
6	6 p. m	105.25	
7	9 a. m	103	
7	6 p. m	104.5	
8	*9 a. m*	103	Inguinal glands very large.

SMALL WHITE PIG, No. 10—Continued.

Date.	Time.	Body temperature.	Remarks.
1880.		° F.	
Oct. 8	6 p. m.	103.5	Very dull, weak. Tail and ears dark blue and cold.
9	9 a. m.	102	
9	6 p. m.	102.75	
10	9 a. m.	101	
10	6 p. m.	102.75	
11	9 a. m.	100	
12	....	....	Found dead. Necropsy the same forenoon.

LESIONS OBSERVED AFTER DEATH.

Skin is generally of a dark bluish red, the color being especially deep on the upper jaw, snout, lower jaw, intermaxillary space, throat, breast, abdomen, eyelids, ears, inner sides of the fore and hind limbs, the outer side of the shoulder, and the perineum. Where the color is lightest (of a dark crimson) it can be partially whitened by pressure; but the white surface remains sprinkled with red spots, and the whole crimsons again instantly on the removal of the pressure.

The *superficial inguinal glands* are enormously enlarged and of a deep red, and at points almost black. The *submaxillary* and *guttural lymphatic glands* are in the same condition; the *prepectoral* are not so much enlarged, but of an intensely dark red.

The margin of the anterior half of the *tongue* has eleven sores with yellow sloughs averaging about a line in diameter, and each surrounded by a dark bluish red areola. A still larger ulcer of the same kind exists on the lower surface of the tongue in front of the frenum. (See illustration, Plate VII, Fig. 2.)

Several of the follicles of the *tonsils* are overdistended with a yellow granular material which can be squeezed out in a vermiform mass.

The *left lung* has nearly the whole anterior lobe hepatized with friable whitish-yellow false membrane on the surface binding it loosely to the pericardium and costal pleura. The lower border of the middle lobe is also covered with false membrane, and is slightly adherent to the ribs; but the lung itself is only to a very slight extent involved.

The *right lung* has a few lobules in each of the anterior and middle lobes hepatized. One hepatized lobule near the posterior margin of the posterior lobe stands out dark, red, and firm; but the lesion is sharply circumscribed by the margin of the lobule in question, and those adjacent to it are quite natural.

The *heart* is normal. A large clot in the right ventricle is slightly buffed.

The *liver* is of a dark purple, and firm in texture. The *bile* of a rich orange color and glutinous.

The *spleen* is apparently normal; there is neither engorgement nor shrinking.

Abdomen.—The *colon* is adherent to the parietal peritoneum at two points near the umbilicus, and at such points there are circumscribed abscesses in the walls of the colon.

The *stomach* has the mucous membrane of its great curvature of a very dark red, at points almost black. The rugæ are very prominent. Near the left *cul de sac* is a circular projecting sloughing ulcer, about 1½ lines in diameter with a dark center, yellow margin, and very dark red areola. This has the general character of the ulcers usually found in the cæcum and colon in this disease. Close to the cardiac are two more similar ulcers with depressed center, encircled by a raised yellow ring of sloughing material, and around this another dark red ring gradually shading off into the hue of the adjacent mucous membrane. The last two ulcers are on the margin of a patch 1 inch long by ⅓ inch broad, covered by a thick bright yellow concretion. (See Plate VIII.)

The *duodenum* is conjested, with dark red petechial patches at intervals. Limited portions of the small intestines have the mucous membrane thickened, softened, and of a deep red, and considerable blood has been effused into the lumen of the gut.

The *ileo cæcal* valve has a few of its glandular follicles distended with a firm yellowish material.

The *cæcum* has one prominent circular sloughing ulcer with dirty yellow center and dark margin; also several black petechial plaques, some of which are already abraded on the surface, and commencing to ulcerate. (See Plate IX.)

The *colon* presents similar ulcers, also plaques of extravasation, and small abscesses under the peritoneal coat, where it was found adherent to the lower wall of the abdomen.

The *rectum* is congested and mottled with dark spots of extravasation and, at one point on the peritoneal surface of the bowel, a thick yellow mass like altered blood.

The *sublumbar, mesenteric* and *gastric glands* are enlarged and congested of a very deep red.

Table showing dates of inoculations and final results.

Number.	Date when received.	Infected by exposure.	INOCULATED.								Died.	
			With fresh virus.	With virus preserved in vacuum tubes.	With virus cultivated in milk.	With virus cultivated in urine.	With virus cultivated in egg albumen.	With virus cultivated in dry bran.	With virus dried on quill.	With liquid exudate slightly putrid.		
1	June 9	1 came sick	June 23	July 10							July 17	Never fully recovered from first attack.
2	do	do	do	do				Sept. 2		Sept. 18	Nov. 24	Died of constipation and encephalitis.
3	June 26	do			July 3						July 18	Never fully recovered from first attack.
4	June 27			July 10			July 3	Sept. 3	Aug. 13	Sept 18	Sept. 29	
5	do	August 10, put in infected pen.		do		July 3		do	do	do	Oct. 2	
6	July 10	August 12, put in infected pen.		do	Aug. 6			do		do	Oct. 19	
7	July 27				July 29	Aug. 6				do	Oct. 21	
8	do		August 13, pus from inoculation swelling.		Aug. 6			Sept. 3		do	Nov. 10	
9	Aug. 23	August 23, put in infected pen.						do	Aug. 23		Oct. 9	
10	do	do						do	do	Sept. 18	Oct. 12	

Table showing the results of inoculations of variable quantities of primary and cultivate virus.

	Number inoculated with 1 drop.	Protected.	Unprotected.	Number inoculated with ½ to 1 drachm.	Protected.	Unprotected.	Died.	Survived.
PRIMARY VIRUS.								
Fresh virus	1	1						1
Virus eight days in sealed tube				5	4	1	4	1
Virus dried on quill	3	2	1				1	2
Virus slightly septic				5	5		5	
CULTIVATED VIRUS.								
In milk				3	2	1	1	2
In albumen				1		1		1
In urine				2	2			2
In bran				*6	*6			
	4	3	1	22	19	3	11 or 16	9

* All very sick, perhaps fatally.

SUMMARY OF RESULTS.

As yet my experiments have been conducted on a limited number of subjects, and therefore cannot be advanced as absolutely conclusive, yet they furnish hopeful indications that by pursuing certain lines of experiments still further we may arrive at a satisfactory means of prevention. So far I have been largely feeling my way so as to discover the channels that promise success, and those that are to be at once discarded as not only useless but dangerous. The avoidance of paths that are known to be perilous serve but to more and more narrow our sphere of acting to those that give the brightest promises. In the following summary I have therefore noted what methods have proved constantly and hopelessly bad, as well as those that have given good promise of success.

1st. *The inoculation of a pig with an excess in quantity of disease-germs is always highly dangerous and often fatal in its results.*—In *ten* successive experiments fatal results followed the inoculation by injection under the skin of one drachm of the virulent fluid. While in the tenth case the death was deferred more than two months and the lesions (constipation and phrenitis) were not such as to warrant the conclusion that the patient died of swine plague, yet the victim drooped after the two last excessive inoculations as he had never done before, and the system was so reduced that he became an easy prey to the last fatal illness.

2d. *Inoculation with a minimum quantity of virus produces relatively less dangerous results.*—In *five* subjects inoculated with a drop or less of fresh virus, all except one survived long enough to show that death was in no way due to that inoculation. The *fifth* and *fatal case* was inoculated eleven days later with a maximum quantity of virus cultivated in wheat-bran, and it is doubtless to this that its death, thirty-six days later, was due.

3d. *Exposure to infection is comparable to inoculation with a minimum amount of virus.*—This is practically shown in the results of exposing the experimental pigs in infected pens, and cohabitation with the sick.

Three subjects thus exposed after they had been protected by a previous inoculation bore the ordeal successfully, and only sickened seriously months later when they had been subjected to the hypodermic injection of a maximum amount of the virulent fluid. Two others that had been placed in infected pens before they had been subjected to any protective inoculation survived such exposure, respectively, for forty-seven and fifty days; and each had been inoculated with a maximum amount of virus, thirty-six and thirty-nine days respectively before death, and finally one had been reinoculated with a maximum quantity twenty-four days before death. The record shows that these two died of the later inoculations and not of the exposure in infected pens. In estimating the worth of the results obtained, therefore, we must not judge in any case by the impotence of any one method to protect against the injection of a maximum dose of very virulent material, but rather by its power to ward off evil results when the subject is simply exposed in an infected building or inoculated with a minimum quantity of virus. The fatal results of the excessive doses served one good result in giving the assurance that it was virulent and not non-virulent matter that was being used.

4th. *Reinoculation with fresh virus during the progress of the disease in a patient does not mitigate the illness nor protect against a further attack, but rather insures and hastens a fatal issue.*—Seven cases (Nos. 1, 3, 4, 5, 6, 8, and 10) show this very distinctly. The conclusion might have been arrived at *a priori* from the fact that such second inoculation was but an addition made to the disease germs which were sapping the springs of life. On the other hand there was the doctrine maintained by Neucki, Bauman, and Wernich that the bacteria are destroyed by the products of the putrefaction they cause, and that the immunity acquired after a first attack is probably due to the presence of such products in the system. Were this the case the greater the numbers of the bacteria and of their products, the earlier should be the recovery. But the undoubted fact that an excessive dose of the poison will overcome the acquired protective influence, and the no less certain fact that the further introduction of diseased germs into the body of a sick subject aggravates the illness, tend to invalidate the position, and to send us elsewhere for a rational explanation of the immunity. The first practical deduction from the result is, that in seeking immunity or protection by subjecting an animal to a mild or mitigated attack of the disease, we must carefully seclude it from all exposure to infection until recovery from the first attack is complete.

5th. *Virulent matter which has been packed firmly in dry wheat bran has its potency increased.*—This I had found to be the case when experimenting on this subject in 1878, and I now made a similar cultivation of the virus to serve as a crucial test of the degree of immunity acquired by an animal in passing through the disease, as contracted in the usual way, and as produced by inoculations with modified virus. Experiment showed, however, that inoculation with a maximum quantity of the bran culture was dangerous in all cases, and that even immunity which resisted an ordinary exposure was comparatively powerless against this. Of seven pigs inoculated with the bran cultivation six were severely ill, one died, and the others were reinoculated with a virulent peritoneal exudate slightly putrid, before they had fully recovered. It is noticeable that this culture in bran, like the preservation of the virus in a corked bottle to be noticed next, determined a growth with a limited supply of air, and the question may well arise whether it is not this culture of the virus without a free access of air which enhances its potency. The solution of this question would have a direct bearing upon the preservation of the poison in infected buildings under tight floors, in wood work, in manure, litter, straw stacks, fodder, &c.

6th. *Partial putrefaction growth of the virulent products in a limited amount of air increases their potency.*—This seemed to occur in a bottle of virulent matter sent me from Illinois in 1878 (see No. 5 of my report for 1879), and now it is fully confirmed by the results of inoculations with peritoneal exudate, and diseased lungs sent me in bottles from New Jersey, and slightly putrid on arrival.

Of seven pigs inoculated with a drachm of this fluid all perished except one (No. 2), which fell off in health and died later of constipation and phrenitis. Experiments conducted in 1878 seemed to show that putrefaction in free air finally destroyed the virus of swine plague, as it is known to do that of malignant anthrax; but in view of the excessive virulence of the liquid that has become slightly putrid with a limited supply of air, it may well be questioned whether swine plague may not be but a modified form of septic infection. I have in progress some experiments which may throw more light on this subject. One pig inoculated with infusion of pork filled with bacteria from inoculation with an infusion of maize was afterward inoculated with fresh virus and placed in an infected pen. He had a sharp attack, but now seems in a fair way to recover. Other experiments on the same subject are in progress.

7th. *Inoculation with a culture of the virus in egg albumen seemed to protect against the effects of a subsequent inoculation with fresh peritoneal exudate, and with virus dried on a quill.*—Subsequent inoculations with a maximum quantity of a culture in wheat bran, and of slightly putrid peritoneal exudate, proved fatal.

8th. *Inoculation with a culture of the virus in human urine protected against the effects of subsequent inoculations with virus that had been preserved in a vacuum tube, and with virus dried on a quill.*—Subsequent inoculations with the culture of the virus in bran, and with the putrid peritoneal exudate, in maximum quantity, proved fatal in both cases.

9th. *Inoculation with the virus cultivated in cow's milk produced a mild attack and an immunity against the effects of exposure in an infected pen, and of inoculation from an infected wound, and secured a mild attack of the inoculation with cultivation in wheat bran.*—Subsequent inoculations with the slightly putrid peritoneal exudate proved fatal in these as in other cases.

EXPERIMENTS NOW IN PROGRESS.

Three pigs are now under experiment to ascertain the protective effect of introducing into the system the products of the fermentation caused by bacteria, while the live bacteria are themselves excluded. *One* was subjected to the products formed in an infusion of pork which had swarmed with bacteria developed from an inoculation with the liquid of decomposing Indian corn. The bacteria was destroyed by heat and the non-vital liquid only was used. Exposed to infection and inoculated, this pig has had a smart attack of illness, but at present seems in a fair way to recover. A *second* was treated with the blood of a sick pig after it had been similarly heated to destroy any existing bacteria, and this was once repeated after the effects of the first inoculation had passed off. A *third* was similarly subjected to devitalized solution of the dung of a sick pig, on one occasion only. These last were in due time placed in an infected pen in company with a sick pig, but so far they have shown no sign of illness.

Should experiments in this line furnish an available method of protection, it must supersede all other modes in which the living disease germs, in however mitigated a form, is introduced into the system. The living germ is always liable to increase from small beginnings to infinite quantities. It is further liable in favorable states of the system to part with its milder characteristics and resume the more virulent and deadly. But if the products of the bacteridian fermentation already elaborated in another system, or in an organic liquid, will so affect the system that it shall become intolerant of the existence and growth of the bacteria within it, we are at once furnished with a mode of prevention which is likely to be as safe in its application as it may be efficient in its results. Toussaint claims that he has in this manner rendered a number of animals insusceptible to the contagion of anthrax, and if hog cholera is, like anthrax, a truly bacteridian disease, there is every reason to hope that it, too, may be prevented in this way. My first subject treated with the products of septic bacteria has not shown an absolute insusceptibility to the infection of hog cholera, yet even she appears likely to make a good recovery. The two thus treated with the products of the bacteria of swine plague have so far appeared to escape all the perils of infection.

Another line of experiment has been adopted to ascertain what relation the propagation of virulent bacteria in the circulating blood which has been deprived of most of its oxygen bears to the generation of swine plague. In my experiments the most fatal type of the poison was that which had undergone a slight putrefactive fermentation in a limited supply of air. In connection with this is the fact that in animals that die of suffocation not only have bacteria entered from the bowels into the blood of the portal vein, but they have become so virulent that a small quantity of such blood inoculated on healthy animals produced fatal results. (*Signol.*) Hogs with their naturally high temperature demand more air in proportion to their body weight than the larger domestic animals, and yet as pigs are now reared and fattened this is usually the last consideration of the owners. I hope soon to be able to show what connection there is, if any, between the deficiency of pure air for the pig and the development *de novo* of hog cholera.

Respectfully submitted.

JAMES LAW.

SUPPLEMENTAL REPORT ON SWINE PLAGUE.

Hon. WILLIAM G. LE DUC,
Commissioner of Agriculture:

SIR: In continuance of my report already sent, I now submit the following further results of my observations and the deductions to be drawn from them. The continuation of my experiments enables me to speak with greater confidence as to results, and the comparison of my own observations with those of others made on allied diseases has served to set certain views in a clearer light, and to establish principles which, I venture to hope, will form the basis of great and invaluable new departures in the field of sanitation. In view of the comparatively limited number of my own experiments on the prevailing plague of swine, I have ventured to introduce illustrative examples from other affections of man and animals, so as to show something of the breadth and solidity of the basis on which stand the principles enunciated. While at first glance this may be thought a deviation from the immediate subject of investigation, I think no one can follow me through without seeing that this apparent digression is of the most vital importance to our study, and to the due substantiation of our results.

RESULTS OBTAINED.

The final results of my investigations may be summed up under two heads: 1st. *The virulence and fatality of the swine-plague germ is increased when grown in a very limited amount of air, and decreases as cultivated in free air.* 2d. *By placing the system of the pig under the influence of the chemical products of the growing swine-plague germ, though the germ itself is not introduced into the economy, the subject is rendered insusceptible to a future attack of the disease.*

1ST. FORCE OF THE VIRUS LESSENED BY CULTIVATION IN FREE AIR.

In my last report I had already indicated that the germ of this disease had in my hands proved much more virulent and deadly if it had been preserved for some days in a sealed bottle, or tightly packed in dry bran. Also, that the same germ as grown in different organic solutions (egg albumen, milk, urine, &c.), with free access to the air through a pledget of cotton wool, had constantly produced mild types of the affection. After my report had been sent I saw for the first time Pasteur's account of his method of mitigating the poison of *chicken cholera*, and Buchner's account of his experiments in the same direction with the poison of *malignant anthrax*. These so fully corroborated my conclusions that I felt more than ever confident in their truth, and as subsequent experiment only tended to further substantiate them, the observation appears now to be warranted that *it is a principle for diseases caused by bacteria, and not recurring a second time in the same system, that the cultivation of the germ in free air mitigates its virulence and fatality.*

To ventilate the question the results of Pasteur and Buchner are given below, together with observations on other diseases pointing to a similar conclusion, and finally my own results with the virus of swine plague.

a. PASTEUR'S METHOD WITH CHICKEN CHOLERA.

Led by his extended observations and long experience in the cultivations of mycrophytes in vinous and other fermentations, Pasteur undertook to produce a variation from the common germ of chicken cholera by cultivating it artificially in infusion of chicken flesh with long intervals of time between the successive cultures. He found that after four months and upwards the products of culture became less deadly to chickens inoculated with it. At first the inoculated chickens would survive a day or two longer, though all finally died. Then with the product of other cultivations of the germ, with still longer intervals, the inoculations did not all prove fatal; first one out of ten would recover, then two, three, four, five, and by and by nine in ten recovered. One step further and no deaths at all took place, the germs, instead of entering the blood and acting destructively there, having confined their ravages to the seat of inoculation, when they led to gangrene of a limited extent of the tissue, which in time sloughed off, leaving a healthy wound that soon healed. The system, however, was affected, and chickens that had been inoculated with this attenuated virus proved to be insusceptible to a further attack of chicken-cholera by exposure to infection.

On the other hand, the chicken-cholera virus which had been inclosed in hermetically-sealed glass tubes, containing two-thirds of the fluid and one-third of air, though set aside for six, eight, and even ten months, lost none of its virulence, and chicken infusion inoculated with the contained germs at the end of this long period became as virulent and as deadly as if it had been inoculated with the virus direct from the chicken. Pasteur logically concluded that the difference was due to the exclusion of the oxygen of the air, which slowly but surely robbed the germ of its fatal power. This was still further supported by the observation that in certain cases, in which the virulence in the cultivated virus had not been materially affected by lapse of time, the layers of the germs developed in the liquid had been so thick that the deeper strata had been to a large extent shut out from the action of the air and consequently remained unchanged.

BUCHNER'S OBSERVATIONS ON BACILLUS ANTHRACIS AND B. SUBTILIS.

It had long been noticed that the microphyte found in infusions of old hay (*Bacillus subtilis*) was practically indistinguishable from the gum of malignant anthrax (*Bacillus anthracis*) as seen under the microscope. The most appreciable distinction was that the *Bacillus subtilis* of old hay could be inoculated on the animal system without any evil result, while inoculation with the *Bacillus anthracis* produced the deadly *malignant anthrax* or *malignant pustule.* The apparent identity of the two, except in their effects, naturally roused the suspicion that the one was but a modified form of the other, though no proof was forthcoming as to the reality of the dimly-suspected transformation, nor the conditions under which it might occur. Finally Dr. Greenfield, of London, found that the cultivation of *Bacillus anthracis* for six generations in aqueous humor robbed it of its virulence and restored it to a condition in which it was indistinguishable from the *Bacillus subtilis.* The true reason of this loss of infective properties did not appear.

Buchner started in the same field, and has not only succeeded in effecting the transformation in both directions, but in demonstrating the cause of the variation. By means of an ingenious apparatus he succeeded in furnishing a fresh supply of boiled infusion of muscle to a vessel in which a culture had just been completed, and without the possibility of the introduction of germs from the atmosphere. In this apparatus he cultivated the *Bacillus anthracis* for several hundred successive generations of the germs. These cultivations, like Dr. Greenfield's, were made with free access of air, filtered from all aerial germs by passing through cotton wool. After a few generations he found that the cultivated fluid was no longer infecting when inoculated on animals. Next he found that instead of the product of cultivation being confined like a white cloud at the bottom of the liquid, a gradually-increasing amount rose to the surface. This scum was at first a thin greasy-looking layer, but this gradually thickened and became dried in successive generations, until it was found to grow readily in an acid hay infusion, and to present all the characters of *Bacillus subtilis.* Here the demonstration is most satisfactory. The virulent germ grown in free air not only loses it infecting qualities, but shows an increasing demand for oxygen by rising to the surface of the cultivation liquid, and ends by acquiring the power of growth in *acid* hay infusion in place of *alkaline* blood and animal fluids, as heretofore.

The converse transformation from the *Bacillus subtilis* of hay to the *Bacillus anthracis* was more difficult, but was finally accomplished. Buchner obtained a supply of defibrinated blood, under antiseptic precautions, inoculated with *Bacillus subtilis*, and kept it in constant motion, so that the scum on the surface should be broken up and the germs mostly beneath the surface of the liquid, a limited amount of oxygen being meanwhile conveyed to them by the constantly-moving red globules. A transitional form soon appeared, which collected in a cloud at the bottom of the liquid after the manner of *Bacillus anthracis*, but the transformation proceeded no further, and the product never became infecting. Nothing discouraged by the failure, and attributing it to the absence of spores, which could not be induced to appear in the blood, Buchner substituted for the latter the extract of meat, with which he was entirely successful. In this the spores formed, virulence was acquired, rabbits and mice were successfully inoculated, and their blood in its turn produced *malignant anthrax* in the animals inoculated with it.

Here we not only find Pasteur's observations confirmed in principle, but that principle carried a step further. The influence of an excess of air or oxygen on the successive generations of the *virulent germ* robs it of its infecting qualities, but on the other hand the growth of the *non-virulent germ* for a series of generations with a very restricted supply of air finally endows it with properties the most deadly.

PRESERVATION OF THE ANTHRAX GERMS IN GRAVES, &C.

Under certain conditions the exposure of the *Bacillus anthracis* to excess of oxygen determines its death. Feltz found that compressed oxygen (15 atmospheres) killed the bacillus, but not the spores. Bert showed that compressed oxygen killed the bacillus, without affecting the qualities of the attendant organic (chemical) poisons. Davaine had shown long previously that the process of putrefaction in the open air led to destruction of bacillus and the loss of infecting power. Later observers have conclusively shown that when the bacillus has formed spores that these can survive the exposure to air and do not break down into an indistinguishable and inert *débris* under the action of oxygen. It has further been shown that the development of spores does not take place in the living animal system, but may take place in suitable conditions after death. The conditions of such growth and of the maintenance of infecting properties may be deduced from the experiments of Buchner recorded above. A free exposure to air and a prompt putrefaction before spores have had time to develop destroys the virus. A very limited supply of air and the retardation of putrefaction afford time for the production of the spores, and is, besides, the precise condition which favors the preservation and increase of their virulence. It will be observed that it is not the entire exclusion of air. Toussaint found that the entire exclusion of the virus from the air in hermetically-sealed glass tubes destroyed its potency in eight or nine days. The condition requisite to its preservation is a restricted supply of air comparable to that met with in the circulating blood or the nutrition liquids of the animal body, or to the flesh infusion in which Buchner transformed the harmless *Bacillus* of *hay* into the deadly *Bacillus* of *anthrax*. It will now be understood why the anthrax poison is preserved in certain soils and graves and destroyed in others. In open, dry, sandy, or gravelly soil, with perfect underdrainage, the bodies of anthrax victims may be buried with comparative safety. The free permeation of such soils by air insures speedy and perfect putrefaction of the animal product, and the *anthrax bacillus* is at once destroyed, while if spores have been already formed they perish in their turn when transformed by development into the bacillus or chain-forms. In close, impervious, or damp soils, on the other hand, on the heavy clays or even porous soils with an impervious subsoil, in the basins of partially-dried ponds and lakes, on the flat alluvial banks of rivers, on deltas, &c., the poison is preserved for years, and the graves of the victims are especially dangerous. In one such case in Livingston County, New York, on a sandy soil over a heavy clay subsoil, the graves were carefully fenced in by my direction, but nearly a year after, during a rainy period, the liquid oozing out on the river bank between the clay and sand, and opposite one of the fenced graves, was licked by six cattle, all of which promptly perished by anthrax. The grave was now fenced in down to the water and no further deaths occurred. Pasteur has shown the virulence of the soil over such graves a year after interment, the germs being most abundant in the earth casts excreted by the worms which bring the spores from the infecting remains of the carcase beneath. Such soils, it will be seen, furnish the condition of a very limited supply of oxygen dissolved in the water with which they are saturated, or in specially dry seasons admitted between the closely packed particles of the soil, which we have already seen to be essential to the preservation and increase of the infecting properties. Hence it is that some such soils in which the anthrax germ has been once implanted become thenceforth *dead lots*, fatal to any herbivora that may be turned upon them. Every fact connected with the life of the anthrax germ strengthens our confidence in the principle to be deduced from the cultivation experiments of Pasteur on the germ of chicken cholera.

ARGUMENT FROM YELLOW FEVER.

While yellow fever differs from the diseases already named in being less of a contagious affection transmissible from man to man, and more a disease of locality or ships, yet it has some points of resemblance which are not without an instructive bearing on the principle (underlying the potency of certain disease germs) that has occupied our attention. It must be acknowledged at the outset that no *disease germ* has been demonstrated as causative of yellow fever. Yet the history of each epidemic almost of necessity implies the existence of such a germ. The disease is introdoced into a foul tropical seaport by an infected vessel, and the sufferers from the fever, and the infected clothing, cargo, or ballast when landed establish so many centers of infection wherever they may be carried, and from which the poison is spread over one or many cities so long as the conditions are favorable to its development. A mere chemical element cannot multiply in this way, and the propagation of yellow fever through a foul city from a single infected victim demands for its explanation that we assume the existence of a living, self-multiplying organism. It does not affect this position though it is shown that the disease is not transferable indefinitely from man to man, or that the poison cannot undergo increase in the human body; it suffices that it can be carried in or about the human body to multiply and grow indefinitely under the combined influence of damp, heat, and foulness outside the diseased economy. The point I wish to make is that we have in connection with this disease and causation of it a germ which can grow and increase out of the body and enlarge the area of the epidemic.

That yellow fever can originate on board ship is proved by a large mass of testimony by La Roche, Faget, Anderson, Potter, Hargis, Gamgee, and others (see Hargis' "Yellow Fever," Gamgee's "Yellow Fever a Nautical Disease," &c.). Take one example from Potter: The Busbridge sailed from England for Madras April 15, 1792, and passing through the tropics far west of the Cape de Verde Isles, and in the yellow-fever zone, developed yellow fever on board, though she had touched at no port since leaving England. A still more striking instance is that of the sloop Mary from a healthy port sent into Philadelphia as a prize in 1799. Her cargo was removed, the decks washed, and the hatches and ports shut down without accident to any one employed on her. In this closed state she lay during three weeks of extremely hot weather, when a very offensive smell of bilge water was traced to the ship. Her ports and hatches were thrown open, torrents of foul air rushed out, spreading a suffocating stench for a considerable distance, and a number of cases of yellow fever, the first in the city, developed in persons exposed to the noxious emanations (Caldwell). Here we find the hitherto harmless contents of the hold developing virulent properties under the combined influence of heat, moisture, and a limited supply of oxygen. The fermentation which went on harmlessly so long as the bilge water and other products were exposed to free air developed a deadly product when that air was partially excluded. Many such cases are on record, and show that the living germ, which must be assumed to exist in an innoxious form in the waters of the western tropical Atlantic, acquires its virulence by propagation in a confined area like a closed ship's hold where it can meet with but a limited amount of air. The converse holds equally true, that free exposure to air puts a limit to the virulence of the yellow-fever germs. This is testified by the board of experts appointed by Congress in 1878, by Dr. Vanderpoel, and by all quarantine surgeons.

In yellow fever, therefore, as in the other diseases named, we find further testimony to the truth of the principle that in diseases due to *microphytes*, virulence is often connected with propagation of the germ in a limited supply of oxygen.

EXAMPLE IN ASIATIC CHOLERA.

It is needless here to enter on the question of the true nature of the cholera *contagium*. Suffice it to say, that in the permanence of this disease on certain rich tropical soils (Asiatic), in its conveyance during the summer season to the remotest parts of the world within the tropics and the temperate zones, in the communication of the disease from man to man in a constantly increasing ratio, and in the preservation of the poison with a successive increase and decrease of its virulence after it has passed out of the animal body, we have ample proof of the existence of some kind of disease-germ which increases by a continuous generation. To render this still clearer the annexed table, by Burdon-Sanderson, may be given, setting forth the virulence of the cholera discharges on given days after they have been passed from the bowels and exposed to the free action of the air. The method was this: Pieces of blotting-paper, dipped in the bowel discharges of the cholera patients, were dried in a free current of air and fed to a given number of mice on each of the first six days after the liquid had been discharged.

Period of decomposition.	Per 100 mice employed in experiment.	
	No. contracted cholera.	No. that died.
First day	11	8
Second day	86	32
Third day	100	21
Fourth day	71	57
Fifth day	40	24
Sixth day	0	0

Here, then, is a manifest increase of virulence for the first three days, showing the capacity of the germ for development outside the animal body, as in the case of yellow fever. The exhaustion of the virulence on the sixth day of development to the action of the air shows the action of the same law that we have seen to hold uniformly in the case of the other poisons examined.

The opposite result of preservation of the cholera poison in a limited amount of air is well shown by the observations of Pettenkofer of Munich. He showed that the following conditions favor the diffusion of the poison and the development of a cholera epidemic, if, indeed, they are not essential to its production. A soil pervious and permeable to water and air, charged with a certain amount of moisture, determined by the presence of stagnant water in the subsoil, and finally with decomposing organic, especially excrementitious, matter. Here, then, we have in the typical soil, favorable to the propagation of the cholera poison, the precise condition found necessary to the preservation of the other disease-germs, namely, growth in an impure and partially deoxygenated atmosphere. In the open air, in Burden-Sanderson's experiments, the virulence was lost after the fifth day, but in the confined interstices of this impure soil it is preserved indefinitely during hot weather, and increases instead of diminishing its infecting properties.

But independently of the condition of soil the deposit of the poison in a confined impure area tends to concentrate and increase its virulence. Thus Orton, Greenboro, Pettenkofer, Barton, and many others have showed that cholera is especially severe and fatal in those infected houses in which a privy odor prevails. The close atmosphere of the sewer serves to secure the preservation of the poison as surely as the interstices of the hot, damp, putrid soil.

EXAMPLE FROM TYPHOID FEVER.

What has just been remarked of cholera and its persistence when the poisonous excreta are thrown into a confined and foul space, is still more characteristic of typhoid fever. Like the germs of cholera, those of typhoid are mainly thrown off by the bowels. If those infecting bowel discharges are exposed on the surface of the soil to the free action of the air, they soon become inocuous. But if they are thrown into a close privy vault, or above all into an unventilated sewer, their virulence increases to a most dangerous extent, and the emanations from such sewers or vaults become incomparably more pestilential than the living patient or his excreta as just passed from the bowels. Of the infection from sewers and pits, Atkins says:

> The specific virus of typhoid fever may be propagated among healthy persons in one of three ways, namely: 1st, by percolation through the soil into wells that supply drinking water to the inhabitants; 2d, by issuing through defects in the sewers into the air of the inhabited area; or, 3d, by exhalation through the apertures of small ill-trapped water-closets or privies, which are at once the receptacles for the discharges of the sick and the daily resort of the healthy. *When the specific poison thus issues into the air, the atmosphere generated is immeasurably more likely to communicate the disease than that which immediately surrounds the fever patients.*

It may be added that typoid fever was actually increased by the construction in towns of unventilated sewers from which the pent up gases forced themselves back into the houses as the most available means of escape, carrying with them the fever germs in an intensely virulent form. This has now been done away with to a large extent by the ventilation of the sewers, which at once tends to reduce the virulence of the inclosed poison and to do away with the pressure which forced it back into the houses.

That the production of typhoid fever by such sewer emanations is due to the specific poison turned into the sewers from a typhoid fever patient and propagated there, and not alone to the gaseous products of ordinary putrefaction, is clearly shown by the observations of Barlow, that while such simple putrid emanations induce fever and ill health, they do not cause a disease which is transmissable from system to system by contagion. In order to do this it is requisite that the virulent excreta of a typhoid fever patient should be turned into the channel containing the decomposing sewage, but when the virus has been introduced it becomes at once more abundant and more potent, and the whole sewer becomes a prolific generator of disease; the ordinary contents of the sewer in a state of decomposition do not generate the typhoid fever poison, but the sewer serves as the most prolific field for its reproduction whenever the poison is introduced into such putrid masses in the confined space.

In typhoid fever, therefore, we have a most potent illustration of a disease germ which increases its potency for evil as it is grown in a suitable material with a partial supply of air.

SWINE PLAGUE VIRUS MORE VIRULENT WHEN GROWN IN A PARTIALLY AERATED MEDIUM.

The examples furnished above, and which might be materially extended, tend to show that it is a rule with disease-poisons of particular type that a certain limitation in the supply of oxygen to the liquids in which they grow intensifies their infecting qualities and renders them more deadly. It will not be surprising, therefore, if we find that the same principle holds in the case of the specific virus of swine plague, or that the converse is true that growth of this disease-germ with free access to air tends to a steady reduction of the infecting power. In illustrating this subject I must draw upon the cases I have given in the two last reports of the Commissioner of Agriculture (1879 and 1880).

INOCULATION WITH VIRUS MODIFIED BY GROWTH IN FREE AIR AND OTHERWISE.

INOCULATIONS WITH VIRUS CULTIVATED IN COW'S MILK WITH ACCESS TO AIR.

1st. A pig (No. 7, present report) was inoculated with milk which had been infected with swine-plague virus *twenty-four hours* before, and kept at 100° to 120° F., with free access to air through cotton wool. The *effects* were *very slight*, consisting of moderate fever and general but temporary ill health. This pig was subsequently inoculated with infected urine without harm, but succumbed to a virulent liquid that had been kept for five days in a sealed bottle with a limited supply of air.

2d. A pig (No. 8, present report) was inoculated with infected milk which had been kept *two days* in an incubator with access to air as before at a temperature of 100° to 120° F.

The *effect* consisted in a *slight fever* only.

3d. On the eighth day this pig was inoculated with infected milk which had been kept *eight days* in the incubator at a temperature of 100° F., with free access of air through cotton wool.

Again there resulted a *slight fever*.

The animal was subsequently inoculated with virulent pus, without effect, but suffered severely from inoculation with virulent material that had been preserved closely packed in bran, and perished from the injection of an excess of virus kept in a closely sealed bottle with a limited supply of air.

4th. A pig (No. 6, present report) previously inoculated from a vacuum tube, in which virus had been shut up for four days, and which had recovered from the effects, was reinoculated with infected milk which had been kept *eight days* in an incubator with free access to air.

The health was scarcely affected.

This subject afterward suffered severely from inoculation with virus which had been kept three days in wheat bran, and perished from inoculation with excess of virus which had been kept in a sealed bottle with little air.

SUMMARY.

Here, two separate animals inoculated with virus modified by growth in milk with free air, resist the second inoculation with the less virulent matter, but fall victims when the more virulent products are introduced into their systems in excess. A third pig, protected in the same way, suffered fatally from two inoculations with very virulent material. The main point made in these experiments is the material reduction of the virulence of the poison which had been cultivated in milk and air. No evil whatever came from four inoculations with it. The minor point is the resistance of the inoculated system to the minor infections. Inoculation with the more virulent products in excessive amount still proved dangerous or fatal.

INOCULATIONS WITH VIRUS CULTIVATED IN EGG-ALBUMEN WITH FREE ACCESS OF AIR.

5th. A pig (No. 4, present report) was inoculated with infected egg-albumen, the virus having been cultivated in this medium for two generations, for two and seven days respectively, at an ordinary July temperature.

The result was a *very slight* and *temporary fever*.

It was afterwards unsuccessfully inoculated on three separate occasions with virus from a vacuum tube, with virus from a quill, and with virus preserved three days in bran, but perished from an inoculation with virus that had been five days in a sealed bottle with one-fifth its volume of air.

6th. A Suffolk pig (No. 8, report 1880) was inoculated with infected albumen, of the fourth generation, that had stood *six days* in an incubator at a temperature of 98° F., with free access to air through cotton wool.

The *result* on the health was *scarcely* perceptible.

The same pig resisted all subsequent inoculations with more virulent products.

SUMMARY.

The first pig, protected by inoculation with a culture of the virus in egg-albumen in free air, resisted repeated inoculations with virulent matter, and perished only when injected with an excessive amount of the most deadly product I have been able to procure. The second pig showed from first to last no susceptibility to inoculation, so that it may have had a native immunity, and therefore we can deduce nothing certain from its record.

INOCULATIONS WITH VIRUS CULTIVATED IN HUMAN URINE WITH FREE ACCESS OF AIR.

7th. A pig (No 5, present report) was inoculated with infected urine of the second generation, the cultivation having extended over *nine days* in all, and the last over *seven days*, at the ordinary July temperature.

The *result* was *slight fever* only.

This pig was afterward inoculated on three successive occasions with virulent matter without visible harm, but finally succumbed to an inoculation with an excess of infecting peritoneal exudation which had been kept *five days* in a sealed bottle with *one-fifth* its volume of air.

8th. A pig (No. 7, present report) formerly inoculated with infected milk was, on the eighth day, reinoculated, this time with infected urine that had been cultivated eight days in an apparatus allowing the free access of air through cotton wool.

The *result* was only *slight fever*.

Forty-three days thereafter this pig was injected with an excess of peritoneal exudate which had stood three days in a sealed bottle with *one-fifth* its bulk of air. It perished on the thirtieth day.

SUMMARY.

Here we have results identical with those of the egg-albumen virus, perfect resistance of the lighter infections, but prostration by an excess of the most virulent products.

INOCULATIONS WITH VIRUS DRIED ON A QUILL.

9th. A pig (No. 4, 1879) was inoculated with the lung exudate from a case that had died suddenly; *one day* only on the quill.

The result was a *violent attack of swine plague*. The patient was killed on the 18th day when already very low.

10th. A pig (No. 6, 1879) inoculated with lung exudate from a pig that had been sick a week or two; the virus was dried on a quill for *one day* only.

Result, a *fatal attack*, death occurring on the 27th day.

11th. A pig (No. 2, 1879) inoculated with pulmonary exudate from sick pig; *two days* dried on the quill.

Result, a subacute attack with death on the 26th day.

12th. A pig (No. 3, 1879) was inoculated with lung exudate which had been dried on a quill *five days* since the death of the sick pig.

The result was a limited fever only and recovery.

The same pig afterward survived inoculation with the matter of an intestinal ulcer, but contracted a chronic form of the illness after inoculation with dried infected intestine *five days after the death* of the pig which furnished it.

13th. A pig (No. 9, present report) was inoculated April 23, 1880, with virulent matter (from North Carolina) which had been *four days* dried on a quill.

The result was very slight other than some diarrhea.

On the eleventh day thereafter the same pig was inoculated with virus (from North Carolina) which had been closely *packed in wheat-bran for three days*. It became seriously ill and died on the thirty-sixth day.

14th. A pig (No. 10, present report) inoculated with virus (from North Carolina) which had been dried on a quill for *four days*. There was scarcely any appreciable derangement of health.

An inoculation on the eleventh day with virus preserved for *three days* in bran produced *slight fever* only, but on the fifteenth day thereafter with peritoneal fluid kept five days in a sealed bottle caused *severe illness*, and death on the twenty-fourth day.

15th. A pig (No. 7, 1879) inoculated with lung exudate (from New Jersey) which had been dried on a quill for *six days*.

The result was a severe form of the plague and death on the twenty-fifth day.

SUMMARY.

Two animals inoculated with virus on quill one day old and one with virus two days old suffer a severe attack; two inoculated with virus four days old and one with matter five days old have mild attacks, and finally one animal inoculated with virus six days old suffers a fatal attack. One hundred per cent. perish from dried virus but one and two days old, while 75 per cent. recover from the effects of virus from four to six days old. The virus from New Jersey used when six days old was shown by other cases to be especially virulent, and while it is idle to speculate further in the absence of exact knowledge, there is the strongest presumption that it was present on the quill in a thick layer, and better wrapped up from contact with the atmosphere than in other cases. On the whole, therefore, the inoculation from quills supports the general principle already seen to hold in the case of cultures in different fields.

INOCULATIONS OF SWINE-PLAGUE VIRUS WHICH HAD BEEN PRESERVED WITH A LIMITED SUPPLY OF OXYGEN.

The two forms in which I have tested this experimentally, were (1) by setting aside a small portion of the diseased intestine, lung, or lymphatic gland in a close vessel packed as firmly as possible with dry wheat-bran, and (2) by placing the virulent liquids direct from the diseased animal with one-fifth their volume of air in a sealed bottle, or, by placing the same products in a glass bulb having its outlet tube drawn out to form a *narrow orifice* (¼ *line*) and tightly packed with cotton wool.

INOCULATIONS WITH VIRUS PRESERVED IN DRY WHEAT-BRAN.

15th. A pig (No. 4, Supplemental Report, 1879) unprotected, was inoculated with a portion of diseased intestinal contents that had been *closely packed in bran for one month.*

The result was a *high fever*, great disorder of the bowels, with bloody fæces, and death on the eighteenth day.

16th. A pig (No. 5, Supplemental Report, 1879), unprotected, was inoculated with a portion of diseased intestine and contents that had been closely packed in bran for one month.

The result was a high fever, great disorder of the bowels, petechiæ, and discolored skin. Was killed the twenty-seventh day.

17th. A pig (No. 13, present list) that had been inoculated from a quill, and made to cohabit with a sick pig without much effect, was reinoculated September 3, 1880, with virluent intestine that had been packed three days in dry wheat-bran.

The result was a severe attack of illness and death on the thirty-sixth day.

18th. A pig (No. 2, Supplemental Report, December 19, 1879), fed a portion of intestinal mucous membrane that had been preserved a month in dry bran.

No evil result was *observable.* The same pig suffered severely from inoculation with fresh infected intestine.

19th. A pig (No. 10, present report) that had been inoculated from a quill and suffered from slight fever only was reinoculated September 3, 1880, with infected intestine which had been packed *three days in bran.*

The result was some amount of fever and ill health, which still existed when it was reinoculated fifteen days later with peritoneal exudate preserved five days in a sealed bottle. After this the sickness increased and death resulted on the twenty-fourth day (October 12).

20th. A pig (No. 8, present report) had been inoculated twice with infected milk and once with pus from an inoculation nodule, but without serious illness; was reinoculated September 3 with diseased intestine which had been packed *three days* in wheat-bran.

The result was only moderate illness.

Was again inoculated September 18 with peritoneal exudate from New Jersey, which proved fatal November 10.

21st. A pig (No. 5, present report) inoculated July 3 with infected urine, July 10 with a pulmonary exudate preserved in a vacuum tube, and August 13 with virulent matter dried on a quill, and had, August 10, been placed in an infected pen, was, September 3, inoculated with infecting intestine that had been kept *three days* in bran.

The result was exceedingly *slight fever* if any.

The same subject was inoculated September 18 with excess of peritoneal fluid kept five days in a closely sealed bottle.

22d. A pig (No. 4, present report) inoculated July 3 with infected egg-albumen, July 10 with liquid from a vacuum tube, and August 13 with virus dried on quill, was, September 3, reinoculated with matter which had been closely packed for *three days* in dry bran.

Result, a moderate fever after the two first inoculations, and about the same amount, or rather a higher fever, after the third.

The same pig was, September 18, inoculated with infecting peritoneal fluid which had been *five days* in a closely-sealed bottle, and died 11 days after.

INOCULATIONS WITH VIRUS KEPT IN CLOSED VESSELS WITH ONE-FIFTH THEIR VOLUME OF AIR.

The experiments under this head were conducted, as stated above, in sealed bottles and in glass bulbs with small outlet closely plugged with cotton wool.

It is needless to specify cases, as all animals inoculated with this culture, without exception, suffered severely and even fatally. It is only necessary to refer to Nos. 1, 3, 4, 5, 7, and 14 in the foregoing list.

GENERAL RESULTS.

My cultivation experiments on the virus were commenced in 1878, with the view of ascertaining what organic liquids modified the virulence of the specific poison. As the experiments progressed, it became evident that there was another element affecting the virulence, namely, the free action of the atmosphere on the preserved or cultivated virus. This was indicated in my report for the present year. Since that was written, subsequent facts have lent themselves to strengthen the evidence; and a review of my entire experience with this disease, together with a comparison of this with analogous results observed in the case of the specific poisons of other diseases more or less closely allied to this, have given to the conclusions all the force of a *principle* dominating widely in this class of affections.

The following tabie will give a "bird's-eye view" of results more striking than any similar amount of writing:

Preservation or culture medium.	No. of generations.	Period of culture.	Air admitted.	No. of subjects.	Results.	
					Slight.	Severe.
Cow's milk	1 to 2	1 to 8 days	Freely	4	4	
Egg-albumen	2 to 4	9 to 10 days	do	2	2	
Human urine	1 to 2	8 to 9 days	do	2	2	
Virus dried on quill		1 day		2	......	2
		2 days		1	......	1
		4 days		2	2	
		5 days		1	1	
		6 days		1	......	1
Dry wheat bran	1	30 days	Very limited	3	1	2
	1	3 days	do	5	3	2
Blood and exudate	1	5 to 11 days	One-fifth volume	6	......	6

With infected organic liquids kept in free air *eight subjects* were inoculated, and *eight survived*, with only slight illness. With infected organic liquids with a very limited access to air *six subjects* were inoculated and *all died*. With virus dried on quills, so that it can undergo slow changes, only *seven subjects* are inoculated, of which *four* are *severely attacked* and *three slightly*. With fresh diseased organ packed tightly in dry bran, and by reason of its moisture more subject to change, *eight subjects* were inoculated, of which *four suffered severely* and *four slightly*. *Three-fifths* had *slight attacks* when the infecting material had been in the bran but *three days*, and *one-third* only when it had been packed for *thirty days*.

DEDUCTIONS—HYGIENIC AND PROPHYLACTIC.

The above facts and conclusions are pregnant with important suggestions in the field of hygiene and prophylactics.

Dangers of storing up the virus and increasing its potency.—1st. It is evident that we must guard more sedulously than ever against the possible storing up of the virus of swine-plague in confined spaces when it has little access to air, and above all when there is superadded organic matter and moisture which may serve to maintain the vitality and assist in the proliferation of the poison.

Herds crowding in straw-stacks and manure-heaps.—We cannot too severely condemn the current practice of allowing pigs to crowd together by scores and hundreds in the *débris* of rotten straw-stacks and dung-heaps, where they lie like sardines in a box, and even piled above each other; the whole, closely enveloped in the masses of decomposing dung or litter, not only shuts out the pure and wholesome air, but generates an abundance of noxious gases to take its place and weaken the system. This doubtless contributes much toward laying the system open to the attack of whatever germ is imported into the herd; it probably does not generate it, otherwise the plague would be even more prevalent than it is. Yet the resulting condition of the blood of the pig, the lack of oxygen, and the growth of the virus in this state of the fluid, in harmony with the principle we have been considering, must enhance its virulence and increase the mortality.

But it is the intensifying of the poison which has passed out of the body which is especially to be feared. Deposits from the breath, skin-exhalations, urine, or dung of the pig, the germs must find in the damp and more firmly-packed lower layers of such refuse, and in the damp, close soil beneath, saturated with decomposing organic matter, the best field for its preservation and for the conservation or increase of its virulence. If the pressure of liquid charged with organic matter could be done away with, the virus would lack for food and would be more readily destroyed. If the air could be freely admitted to all parts of the mass and soil, the virus would soon perish or be transformed into a harmless material. But as it is, this warm bed of the herd supplies the conditions which we have found to be essential to the preservation of the plague-germs and to the increase of its potency.

In connection with this question it is no manifest consideration that among our domestic quadrupeds the pig requires the very largest amount of oxygen in proportion to its body-weight. The following table, condensed from a large one by Colin (*Physiologie Compiarée des Animaux*), will illustrate this:

Animals.	Oxygen consumed in 24 hours per kilogramme of body-weight.	Carbon burned in 24 hours per kilogramme of body-weight.	Carbonic anhydride exhaled in 1 hour per kilogramme of body-weight.
	Grammes.	*Grammes.*	*Litres.*
Horse	13.272	5.080	0.393
Cow	11.040	4.129	0.320
Ass	13.577	5.080	0.393
Pig	29.698	11.166	0.867
Sheep	29.314	7.638	0.593
Dog	28.392	7.621	0.607
Cat	28.475	7.748	0.605
Rabbit	21.192	7.200	0.562

From this it appears that to every pound of his body-weight the pig consumes more than double the amount of oxygen used up by the horse or cow, and of course reduces a correspondingly greater amount of air to a condition that will not support respiration. If, therefore, the pig is compelled to breathe impure air, as in the conditions above referred to, his blood must sooner be deprived of the oxygen contained in it, and be reduced to that condition which we have seen is most favorable to the virulence and potency of the disease-germ. But the owner should consider that in the conditions named the virus finds the most appropriate media for its propagation and virulence within and without the body alike, and should carefully seclude his stock from exposure to such insalubrious conditions.

CROWDING IN CONFINED SPACES UNDER BARNS.

Hardly less suggestive of the intensifying of the poison is the herding of pigs, and especially in large numbers, in a confined space under barns occupied by other animals. Here the solid and liquid excretions of the stock above pass, to a certain extent, through the floor, and thus mixing with the excretions and exhalations of the pigs, accumulate in the confined area, saturate the ground, and determine constant emanations that deteriorate the air and undermine the health of the animals that crowd together in the close and stagnant atmosphere. The soil under such barns, charged with decomposing organic matter, presents the means for the preservation and germination of the virus, and the paucity of air driven out of the soil by the gaseous products is that best calculated to secure an increase of virulence. Such sleeping-places may, therefore, be set down with manure-heaps and rotten straw stacks as *propagators*, though they may not be *germinators* of the plague. In the present state of the swine industry in the Western States, the swine plague is so wide-spread that the chances are always favorable to the extension of the contagion, and no herd, however well cared for, can be looked upon as safe; yet the danger must be greatly enhanced by that management which so surely contributes to the multiplication and potency of the germ.

CLOSED SPACES BENEATH THE FLOORS.

One of the worst conceivable arrangements in a pig-pen is a wooden floor covering a dark, closed space all but impervious to air. Into such a closed space the liquid excretions will sooner or later penetrate, carrying with them the infecting matter of any diseased animal above. There, over a putrid soil, in a close, foul atmosphere, it has every opportunity of maintaining and increasing its virulence, and of surviving for weeks, months, or years to prove the center of frequent and disastrous outbreaks. The conditions are sufficiently like those connected with the generation of yellow fever and typhus, and of the conservation of these together with cholera and typhoid, to deter any one from constructing or preserving such an incubator of poison.

OBJECTION TO WOODEN FLOORS AND WALLS.

In the light of our facts and observations, every one must perceive the objection to wooden floors and walls in pig-pens, likely to receive the germs of swine plague. The joints and cracks in wooden buildings, and the rotten wood, become filled up with dry or moist excretions, ready to receive and even to propagate the disease germs. Then, above all, in the case of the floors, the wood becomes saturated throughout with such products, and as it is kept moist the germ once introduced and developing must make increase with a minimum of air, and will thereby retain or strengthen its potency.

To obviate this something might be secured by thoroughly soaking the timbers with oil before constructing the building; but an ideal floor would be an impermeable one—paved with glazed brick, flags, or cobblestones and jointed with Roman cement. The walls constructed of hard burned brick, stone, or cement, could, with such a floor, be frequently flushed with water and kept perfectly pure.

OBJECTION TO CLOSE DRAINS AND LIQUID MANURE PITS.

So-called improvements are often fraught with unseen dangers. Unventilated sewers serve to spread typhoid fever, diphtheria, and cholera; warm, air-tight barns propagate consumption and glanders, and so close covered drains and cesspools, or liquid manure tanks, are liable to spread hog cholera. If these last are indulged in they should be properly ventilated by inlets for fresh air at their lower ends and outlets at their upper, and the latter should on no account be allowed to open into a close pig-pen to befoul its atmosphere. Emanations from such close, confined drains and pits are always unsanitary and injurious to animals requiring such abundance of pure air as do swine, but they must become pre-eminently plague-pits and passages once the hog cholera germ has been introduced into them.

DANGERS FROM RAILROAD CARS AND FROM VESSELS.

It must be apparent that many of the objections to wooden piggeries apply no less to railroad cars. The joints and crevices, the accumulations of filth, and the absence of all systematic disinfection, the constant use of the cars for successive loads of swine, and the impossibility of obtaining perfect drying and aeration in the intervals, all combine to make these vehicles the bearers and disseminators of contagion. The absence of air in the masses of accumulated manure, and in the interstices of the wooden floor or wall will even go far towards adding a new force and malignancy to the poison that may be introduced. In ships and boats there is the additional danger of the close atmosphere between decks and the bilge water in the hold.

Much may be done to obviate the danger by thoroughly soaking the wood-work of the cars and ships, but especially the floors, in oil, which will prevent the imbibition of other liquids. But in an infected country nothing can replace the thorough cleansing and disinfection of these cars and ships before they are to be used on any occasion for the conveyance of store animals.

RAILROAD AND MARKET YARDS AND BUILDINGS.

As the rendezvous for great herds of swine these are surrounded by all the dangers of wooden piggeries and the additional risks of infection attended on the railroad cars. The virulent droppings from one herd remain in the wood-work, joints, and cracks, in the intervals between the paving stones, in the closed spaces beneath the floors, and in drains, &c., to infect other herds which pass through the same place in rapid succession. In the accumulated refuse, and especially in the closed buildings and drains, there is the special danger of the specific poison attaining increased virulence and malignity and spreading a more inveterate type of the malady than that from which it was derived. The minute precautions advised for cars and boats are equally demanded for public yards and buildings to be used for store swine.

VARYING SEASONS WILL FAVOR A VARYING MORTALITY.

It is not our purpose now to estimate the influence of electrical disturbances on the growth and quality of the poison, as that has not entered into our premises. In passing over these, however, we must not be held to ignore the great influence exerted on fermentations by varying states of electrical tension, and the strong presumption that a poison, such as that of hog cholera, is similarly affected, and especially where outside the body. What we would especially call attention to is the varying condition of the soil as serving to preserve or modify the growth of the disease poison.

WHY SUMMER IS THE MOST DANGEROUS SEASON.

Various considerations will show the especial danger of summer. In winter the soil is bound up in frost, and even though the disease germ may be present in the earth, it is closely sealed and usually harmless. The hard surface cannot be broken up by *rooting*, and therefore the germ cannot be set free until the occurrence of the thaw. The germ cannot multiply in the soil, being laid up, not dead, but inactive like the dried and stored seed, ready to start a new growth and increase when subjected to the warmth and moisture of spring and summer. Thus it is that the disease often disappears during the winter months but breaks out anew on the return of genial weather.

In summer, on the other hand, the frozen germ in the soil, building, or other place, is free to grow and multiply, and though buried more or less deeply it is constantly liable to be set free by the *rooting* of the hog. The germs thus *rooted* up from a depth in the soil are likely to be far more dangerous than those that may have been left on the surface, having met with little air to determine a salutary modification. In summer, too, the hog exposed to the scorching rays of the sun is rendered feverish and more susceptible to the action of disease poisons. The air that he breathes is much more rarefied, contains far less oxygen in a given volume, and thus the aeration of the blood is likely to be less perfect than in colder weather, and the blood to prove more conducive to the production of a malignant germ. If the hogs are fed, as is too often the case, even in the extreme heat of summer, almost exclusively on Indian corn of the preceding year's crop, this adds its quota of costiveness, intestinal irritation, and fever, to favor the disease in its worst type. Finally, it need not be overlooked that summer is the season of the greatest number of hogs, and especially of young hogs that have never had the plague, and are therefore especially susceptible to its ravages.

DRY SEASONS ON PARTICULAR SOILS.

In dry, hot seasons not only are clay and other soils covered by a hard beaten crust comparatively impervious to air, but the soil beneath, also dry, is filled with the gaseous products of organic decay, which drive out the wholesome atmospheric air and prevent its entrance. The germs lodged in such a soil at a sufficient depth to bring them in contact with some moisture are in precisely those conditions of a limited amount of oxygen in which they can develop their most redoubtable qualities. If the soil in question is naturally rich in organic matter, or if, as is usually the case in piggeries, it has been thoroughly charged with the secretions of the animals, the conditions are at their worst, as the organic matter furnishes food for the growth of the germ and the comparative absence of air tends to its more malignant development.

The drying up of drains, pools, and pits during summer and autumn further favors the escape of germs that may have remained in the soil beneath harmless, until they could rise on the air in the gaseous emanations or be grubbed up by the snout of the pig. So with the virulent germs in the wood-work and beneath the floors. These may easily escape in infinitessimal particles from the open and cracking wood or the dry area beneath, though they had been hitherto bound up by the moisture.

EFFECT OF WET SEASONS ON CERTAIN SOILS.

Specially wet seasons operate in another way. By the heavy rainfall the soil is filled with water. If both soil and subsoil is gravelly or sandy, and if the fall is sufficient for good drainage, this soon passes off, and the germs are washed away, or, if not, are early disinfected by the action of the air. But in the rich alluvial soil, and clay which is more retentive of moisture, and in even the sandy and gravelly surface soils that have a subsoil of clay or other impervious material, or that are so low or so level that natural drainage is impossible, there is a water-logged condition approaching more or less near to the surface, and just so far as the soil is charged with water it is to a large extent emptied of air. The water-logged soil can only retain as much oxygen as the water will dissolve, and while at the best this must be limited, it must be diminished in exact ratio with the pressure of the gases derived from the earth. It must be manifest, therefore, that soils that are at once rich in organic matter and from any cause retentive of water, wet seasons must often add to the potency of the swine-plague germ by determining its growth in a limited supply of air.

VALUE OF LOOSE DRY EARTH AS A DISINFECTANT.

This appears to depend largely on its antiseptic and deodorizing properties. Finely-powdered dry loam or clay is a direct antiseptic, and has the power of absorbing the noxious gases produced by organic decomposition and the growth of bacteria. It is besides porous in an eminent degree, and this transmits through its substance a large amount of atmospheric air and determines the less obnoxious fermentation. Hence in earth closets the disagreeable odor may be entirely suppressed; in the case of anthrax carcasses the virulence may in time disappear; and in hog cholera the same good result may finally be attained. But it must be observed it is the dry, pulverulent, porous earth alone that will act in this way. Moisten it and pack it firmly and its good qualities may be at once exchanged for evil ones, and it may become a dangerous propagator in place of a destroyer of infection. Dry earth is not a potent and speedy disinfectant like chloride of zinc or lime; it will act slowly in this way if perfectly dry, open, and porous, but saturated with moisture or closely compressed, its good qualities are in the main lost. It may be used in certain cases as an auxiliary to other disinfectants, and its action is mainly valuable as showing how the porous dry soils are slowly but permanently destructive to such poisons as those of anthrax, chicken cholera, and swine plague.

PROTECTION BY INOCULATION WITH THE MITIGATED VIRUS.

What has been said on inoculations with the two forms of virus grown respectively in muscle and little air seems to establish the fact that the first-named form produces a mild type of the disease, rarely or never fatal, and that this protects to a reasonable extent against any subsequent attack from exposure to infection. In short, we seem to have here placed in our hands a means of protecting individual hogs and herds against heavy mortality from swine plague, which yearly claims its tens of thousands of victims. We have something apparently as valuable as the protective inoculation against small-pox, or lung plague, or even chicken cholera. It is not enough, however, to set forth the benefits; the drawbacks also must be advanced.

DRAWBACKS TO PROTECTIVE INOCULATION WITH MITIGATED VIRUS.

1st. *The protective inoculation retards growth and thriving.*—Just how far this will affect the animal I am not yet prepared to say, yet in my cases it kept back the subject for one or several weeks. In a short-lived animal like the pig this is of some consequence, though admittedly of incomparably less than the present losses from hog-cholera.

2d. *The method is a cause of the preservation of the disease-germ.*—This is a much more weighty objection. To protect a herd that is liable to be exposed to infection we must transmit to each animal the germ of the plague itself. The germ it is true will prove all but harmless to the animals inoculated, but it will propagate in their systems and be deposited in their dwellings and yards, and if in either it meets with those conditions, which will serve to increase its virulence, it will be liable to speedily assume its deadly form and type. Let the living germ be put up in wood-work, or beneath it in drain or pit, in litter or manure, in puddled or water-logged soil, as above described, and it may soon be transformed from a benignant to a malignant poison. Let this once take place, and every new pig introduced by birth or otherwise is liable to contract the fatal form of the malady and to become the starting point for a new and disastrous outbreak. The same transformation to a virulent type may take place spontaneously in the bodies of certain animals on account of coexistent fever or other bodily disorder.

Protective inoculation with this mitigated virus is too closely allied to the inoculation of flocks with sheep-pox or of human beings with small-pox. There can be no doubt that the habitual high mortality of these diseases may be almost entirely obviated in this way, but the disease-germ is reproduced to an indefinite extent, and there is ever the danger of uninoculated and susceptible subjects from outside or born in the place contracting the malady in its most deadly form. So of the inoculation for swine plague with even mitigated virus. To render it perfectly safe it must be done under disinfecting precautions. The subjects should be kept in a building with paved or cement floors and lower walls, so that there may be no opportunity for the storing up of the disease-germ; their excretions must be regularly and thoroughly disinfected; all drains must be carefully attended to in the same way, and finally, on full recovery, the place must be subjected to a thorough disinfection. It might doubtless be often safely accomplished on open porous soils naturally well drained, where the germs of the disease would be early destroyed, and where there was no wet spot, pond, stream, building, or other place where the virus could be shut up and preserved or intensified. The greatest care, too, would be needful to prevent the escape of the infected or the approach of other animals, and to seclude the ground from pigs, sheep, rabbits, and other susceptible creatures for a length of time after a full recovery.

INOCULATION OF HERDS THAT ARE ALREADY INFECTED.

It can rarely be desirable to inoculate herds, unless they already have the infection in their midst, or are so much exposed that they can scarcely fail to contract the malady if left to themselves. But in these conditions it may evidently be adopted with decided advantage if intelligently carried out.

The first measure would be to remove the whole herd from the buildings and inclosures in which the more virulent germ had been deposited, excepting only such pigs as show by their elevated temperature, enlarged glands, cough, disturbed digestion, discolored skin, or other symptom, that they were already infected. They should be placed in a building or place as above indicated, where a subsequent thorough disinfection could be applied. They should be carefully watched after inoculation, and if any one has developed the malignant type of the disease it should be at once removed from the herd and destroyed or otherwise safely taken care of.

Pains should be taken to supply pure air and surroundings, to avoid extremes of heat and cold, to give gently-laxative and easily-digested food, and to correct any unhealthy condition of the functions, above all of digestion. Finally, when all have recovered, disinfection of the premises should be conducted in a very thorough manner.

2.—PROTECTIVE INFLUENCE OF THE CHEMICAL PRODUCTS OF THE SWINE-PLAGUE GERM.

Bacteria intoxication and bacteria infection.—In all diseases caused by microphytes, there are two associated but distinct deleterious agents to be taken into account: 1st, the organism which is introduced from without and multiplies in the body of the patient; 2d, the chemical products elaborated by the growth and increase of the imported organism at the expense of the vital liquids. The two have been aptly named bacteria infection and bacteria intoxication. Each may be injurious, and even fatal, yet each has its special mode of action and its limitations, so that we can estimate with a reasonable amount of certainty the probable results in the two cases.

In *bacteria* infection the self-multiplying organism is introduced into the body, and if it finds a suitable field for its growth it undergoes an indefinite increase, and may undermine the health or destroy life in one of various ways; for example, by accumulating in the capillaries, arresting the flow of blood and abolishing the functions of vital organs, or leading to local abscess or gangrene; by abstracting oxygen and other essential elements from the blood, and resolving this vital fluid into a poisonous in place of a life-giving stream; or by reproducing itself in myriads, elaborating a vast amount of noxious chemical products and killing by poisoning. The *bacteria intoxication* or *poisoning*, on the other hand, is affected directly by the products of the growth of the bacteria, or in other words, by a chemical compound incapable in itself of reproducing or increasing its substance. The respective powers and limitations of the two poisons may thus be mapped out with great clearness.

It is manifest that from *bacteria infection* may be derived nearly all the evil results of *bacteria intoxication*, in addition to certain pernicious actions peculiarly its own. The germ being a living organism, with limitless powers of growth, it is manifest that apart from the power of the system to support it, there can be no bound to the amount of chemical poisonous product it may generate, and thus to its own special work of destruction of the essential constituents of the blood, deoxidation of the vital fluid, plugging of vessels, local abscess and gangrene, it must ever add the poisonous influences of its purely chemical products. But it has its limitations as well, which do not belong to its products. In several bacteridian diseases the system will not sustain nor nourish the bacteria with the same readiness a second time if at all. The system that has once sustained an attack does not readily succumb to the same again. An incompatibility or antagonism has been established between the system thus protected and the bacterium, and henceforth the system may be repeatedly inoculated with the bacterium with the most perfect impunity. This cannot be said of the chemical products of the bacteria growth. These, like all chemical poisons, will act again and again upon the same system with little difference in effect, and if a partial tolerance of their presence is acquired it can only be to a limited extent and after long exposure to their action, as tipplers acquire a tolerance of alcohol, or opium or arsenic eaters of these respective poisons. Kill the mycrophytes in the infecting bacteria liquids, and the chemical products will act in exact ratio with the dose administered, and no amount of experience with the poison will prevent an excessive dose proving fatal. The action moreover will be prompt, and if it does not produce fatal results at an early stage it will gradually subside, for since the poison cannot multiply itself its effects must steadily decrease with its elimination from the system. With *bacteria infection*, on the other hand, the evil effects must be somewhat delayed to allow of the reproduction of the germ and the production of the chemical poison, and thus the disorder of the system will undergo a progressive development. In another respect we may conceive of the bacteria infection being limited in its evil results. If the bacteria increase slowly the system will be likely to become somewhat habituated to the influence of the poison and insusceptible to it, so that by the time the disease reaches its height the system may be able to bear with impunity a quantity of the poison which it could not have tolerated had the same amount been introduced suddenly and before the economy had become inured to its influence.

In illustration of the separate action of the bacteria and their chemical products, Koch's experiments on mice with putrid fluids are most instructive. These were made with putrid liquid, but serve none the less to illustrate bacteridian poisoning. Koch injected putrid liquids under the skin of the mouse, and found when the amount used had been excessive that the mouse died in a few hours from the effects of the chemical poison, and that not a bacillus could be found in the blood within the vessels. If, on the other hand, a minimum amount of the putrid liquid was used, as by making a slight scratch with a lancet, the tip of which had been dipped in the liquid, and if the mouse survived the primary danger of death by the chemical poison it died in the course of about two days of bacteridian infection, and the blood was found swarming with bacteria. Similarly, Chauveau found that Algerian sheep, that are naturally insusceptible to *anthrax*, and which had successfully resisted inoculation with a minimum amount of the virus, fell victims to the disease if an excess of the poison were injected under the skin, or if a second and third inoculation were practiced before the effects of the first had passed off. Finally, Cossar, Ewart, and Burdon-Sanderson found that when anthrax liquids had been devitalized by exposure for some time to compressed oxygen (12 atmospheres), and when the germs (bacillus, and spores) had lost their power of propagation and increase, the fluid still proved injurious, and even fatal to animals on which it was inoculated. With the vital germ destroyed, these evil effects could only come of the remaining chemical poisonous products, which retained their original potency.

My own experiments on the virus of hog-cholera tend to establish the same fact in that disease. When I had subjected the virulent fluids for an hour to a temperature oscillating between 130° and 140° F., and then inoculated them on the pig, I found that the result was a certain amount of constitutional disorder and ill health, which did not, however, go on to a fatal issue. Here I presume, though I cannot prove, that the disease germ had perished, and that the effects were due to the chemical products alone. Similarly, when I injected into the system large quantities of the virulent fluids, I found that death took place almost without exception, even in animals that had resisted ordinary inoculations. Of this mortality we may find an explanation in the febrile state of the system, induced by the presence of the chemical poison. Davaine found that Guinea pigs died in summer from the inoculation with $\frac{1}{1000}$ of the amount of putrid blood found necessary to kill the same animals in winter. This may be partly due to the excess of bacteria present in the air in summer, and introduced into the putrefying fluid, but was doubtless further influenced by the relaxed and susceptible condition of the system of the animals operated on. The observations of Chauveau and my own, that the inoculation with an excess of the virulent bacteria fluid will overcome the resisting power of a comparatively insusceptible animal and induce a fatal result, tend to establish the same conclusion. The organic poison in such cases would undoubtedly induce fever, and the derangement of functions and assimilation attendant on the fever would break down the vital barriers and cause the blood globules and tissues to succumb to the attacks of the bacteria. The deduction is further corroborated by the morbid and even fatal results obtained by repeated inoculations at short intervals with virulent bacteria fluids. Chauveau's experiments on Algerian sheep with anthrax fluids and my own on pigs with swine-plague virus show clearly that the introduction into the system of fresh virulent bacteria fluids before a former inoculation had spent itself and had its products eliminated, enhanced the violence of the attack and often induced a fatal result. Here it is not the increase in the number of the bacteria alone, nor the access of fresh, and therefore more potent, germs that have the evil effects, for in the infected system there is practically no limit to the multiplication of the bacteria, and these, in place of being weakened, are often rendered more potent by passing through a succession of animal systems. It is probably largely due to a sudden access of the irritating chemical products along with the fresh bacteria.

Is future protection secured by the action of the chemical products alone, or is the presence in the system of the bacteria essential?—If we knew positively on what the protection from a second attack of the same infectious disease immediately depends, we could give a scientific answer to this question, but while our views of the mode of such protection are merely hypothetical we can only indulge in inferences which may be more or less reasonable. Some have supposed that there is eliminated from the system during the first attack some element, the presence of which is necessary to the maintenance and propagation of the disease germ, but they fail to show why this particular element is not in itself reproduced in after life as it was in time past. Others hold that the chemical products of the growth of the bacteria are left in the system and prove fatal to the bacteria germs if again introduced. But this is negatived by the fact that these same virulent bacteria continue to grow in the same vessel, and in spite of the presence of their chemical products, if fresh infusion of meat is introduced. Moreover, both of these assumptions appear to be disproved by the fact that a large dose of the virulent bacteria fluid in a refractory system will overcome the apparent immunity and lay the animal under the sway of the disease. If the immunity were due, either to the abstraction of an element essential to the bacteria or the presence of a product inimical to them, the results would be of an entirely opposite kind, and the subject would be as much proof against a large dose as a small one. A third hypothesis, at one time supported by Toussaint in the case of anthrax, was that, by the earlier attack, inflammation of the lymphatic glands was induced and an amount of condensation, which in the future enabled them to filter the bacteria out of the liquids passing through them, and thus to prevent the infection of the general system. This view was thought to receive strong confirmation from the fact that bacteria, thrown into the blood, are usually filtered out of it by the capillaries in the course of a few hours, and that the blood of the fœtus in the womb of a pregnant animal has never been found to contain the bacillus anthracis, though the dam may have perished with that disease and though her blood may have swarmed with the germs. But the advocates of this hypothesis overlooked the facts that the occurrence of inflammation, condensation, enlargement, and other structural changes of the lymphatic glands (as from tuberculosis, cancer, lymphadenoma, &c.,) offered no protection against a subsequent attack of anthrax; and that though the bacteria thrown into the blood disappeared within a few hours, they reappeared later in countless numbers when they had had time for reproduction in the circulatory system.

Then with regard to the *fœtus in utero* there is another influence which curiously enough has hitherto escaped recognition by all observers and writers on this subject. *The fœtus is essentially a carnivorous animal;* it lives solely on the products elaborated for it in the maternal system, and thus has a claim to the comparative immunity from anthrax which appears to pertain to all animals that feed on flesh alone. This immunity has been shown to belong less to the germs than to the kind of food furnished. Thus foxes and rats were alike refractory to anthrax when their diet was restricted to flesh, but both fell easy victims if first fed for some time on vegetable food. Like the carnivorous animal the *fœtus in utero* is sustained exclusively by the products of the animal economy, and it is much more reasonable to suppose that in this lies the secret of its immunity from anthrax, than that the fœtal membranes form a filter more efficient than the mucous membranes and skin show themselves to be in the case of the mother. The only other hypothesis that need be mentioned maintains that the organized elements of the body—blood-globules, nuclei, &c.—by reason of their first exposure to the poison become physiologically insusceptible to its pernicious effects, just as a drunkard becomes proof against large doses of alcohol, an opium eater against morphia, or a smoker against tobacco. In each of these cases the susceptibility to the poison is not altogether lost, but a large dose may still prove fatal, and this is precisely what holds also in the bacteridian diseases. It may be opposed to this view that the blood globules, nuclei, and other living and assimilating elements of the body are not permanent but are continually changing, new generations constantly taking the place of the old, and that it is irrational to suppose that this refractory habit towards a particular poison can be transmitted through ten, twenty, fifty, or one hundred generations without being exhausted, and that if this can be the case in the individual system it should be equally true for the family, for as the offspring results from the growth of two vital elements of the parents, it should inherit the acquired immunity to a particular disease as it inherits the other personal attributes of the parent. But the cases are not exactly parallel. The germs supplied by the parents as the starting point of the future animal, though they have within them all the powers of nutrition, growth, and development which should issue in a new being, the counterpart of its parents, are yet susceptible of changes and peculiarities of development that do not belong to the nuclei which preside over the nutrition and growth of the tissues of the fully-formed animal body.

The embryonic cell at first grows and multiplies only without any manifest tendency to differentiation. Later, when the different organs of the new being are to be formed, the cells take on powers according to their location; one set of cells build up vessels, another set produce nervous tissue, a third set cartilage, a fourth, muscle, a fifth, tendon, and so on until the entire body is completed in all its harmony and symmetry. But with the formation of the different tissues the cells that preside over their formation have their functions narrowly restricted to certain well-defined limits. At an earlier stage anything that interferes with the growth and nutrition of the embryonic cell will cause an arrest, redundancy, or modification of the future animal; thus distortions, malformations, and monstrosities of the chick may be determined by varnishing in various ways the shell of an egg. But when the body has once been formed out of these plastic and unstable embryonic cells, their descendants can only, in health, produce the tissue in the midst of which they lie and that only to a limited extent and in a definite form. The nuclei of muscle, nerve, and bone can respectively build up but muscle, nerve, and bone, and the form of the particular muscle, nerve, or bone in which the lot of each has been cast. When we thus see the progeny of the germ cell or the embryonic cell losing all the powers of varied growth and development which were inherent in their parents and limited for the future to one definite and invariable process in nutrition and growth, we can well imagine how the same germ cells in developing into the animal body should part also with that refractory attitude toward a specific disease which was the prerogative of the parent organism.

This view is further strengthened by the fact that though an animal that has acquired an immunity from a specific disease afterward produces offspring which are susceptible to the disease in question, yet it has been shown in the case of anthrax, that if such immunity on the part of the parent has been acquired by a non-fatal attack of the affection during advanced pregnancy, the preservative effect is extended to the fœtus as well. Here the fœtus has advanced beyond the condition of an ovum, or of simple embryonic cells or tissue, and is already well formed, with all its differentiated bones, muscles, tendons, brain, nerves, vessels, and viscera. The nuclei presiding over the growth of these different structures are henceforth fixed in their powers, and any habitude impressed upon them may now be permanently preserved just as it is in the adult animal.

This consideration serves to fortify the doctrine that the immunity from a contagious disease acquired by a first attack is due to a habit, or acquired power of endurance or resistance on the part of the living cells or nuclei of the animal body. The doctrine it is true is not absolutely proved—it must remain as a hypothetical proposition; but it better accords with and explains observed facts, and is liable to fewer objections than any theory on the subject that has come under our notice. We may accept it therefore as a working theory subject to revision at any future time, should further developments demand this.

To return to our question. Do the observed facts accord best with the idea that protection is acquired by the action of the chemical products of the bacteria alone, or is the presence in the system of the bacteria essential? As the question appears to us everything serves to support the first conclusion. *A priori*, a dead bacterium can no more render the system or the tissue non-receptive of the live bacterium than can any other similar infinitesimal particle of dead matter. Again, if it were merely the mechanical effects of the bacteria in the capillary blood-vessels and tissues that secured the protection, one bacterium should be absolutely protective against the attack of another—the animal that has suffered from anthrax should be insusceptible to septicæmia and vice versa. But excepting in the case of anthrax and chicken cholera no such mutual vicarious action has been shown to exist.

The facts attending the acquired immunity of the advanced but unborn offspring of an anthrax mother seem to be almost conclusive on this question. The blood of the dam may be swarming with bacteria, but these have never been found in the blood of the fœtus. It is only reasonable to conclude that they have never entered the body of the fœtus, or if otherwise that they have perished very soon after they entered. The chemical products, on the other hand, being soluble in the vital fluids presumably enter the fœtal system along with the maternal secretions. The offspring when born proves refractory to anthrax, so that there is the strongest presumption that it has been fortified by the action of the chemical products of the anthrax upon its system before birth. In this case immunity cannot well have resulted from any action of the growing and multiplying bacteria on the blood or living tissues, for the evidence is all opposed to the idea of their presence, at any time, in the fœtal system, much more to their growth and propagation there. Yet here unquestionably the disease in the mother has produced an insusceptibility in the fœtus, such as would occur had it been itself the subject of the disease. It follows almost of necessity that the introduction into the system of the chemical products of the bacteria is equivalent in a protective sense to the introduction of the bacteria themselves. But the mere chemical products cannot undergo increase in the system; therefore, we can graduate the dose of these as safely as we can a dose of opium or rhubarb.

With this presumptive evidence we are prepared to study the direct results of the introduction into the system of the chemical products of anthrax and swine plague made with the view of securing an insusceptibility to these respective diseases in the future.

Toussaint's results.—Toussaint employed two different methods for the removal and destruction of the bacteria from his anthrax liquids. First, he filtered the anthrax blood through a linen cloth and ten or twelve folds of filter-paper, having first defibrinated it to secure readier filtration. But the method mostly successful sometimes failed on account of the escape of bacteria through the filter, and was always difficult to manipulate by reason of the clogging of the filter. Second, he sought to destroy the vitality of the bacteria by heating the anthrax liquid for fifteen minutes to a temperature of 55° centigrade (131° F.). To prevent further change he then added carbolic acid at the rate of a drop or two to each ounce of the heated liquid.

Whether Toussaint succeeded in destroying the vitality of all the bacteria by this last method may well be questioned. Yet the results showed that he had at least so far reduced their vitality and virulence that they could as a rule be thrown into the system of an animal without producing fatal results, but with the effect of rendering that system refractory to the disease for the future. In his first experiment five sheep were inoculated with the *supposed devitalized* anthrax blood. Later these were inoculated with the fresh anthrax blood of a rabbit. One died and four survived. The four sheep were now again injected with the devitalized blood of the dead sheep, and though they have been twice since inoculated with fresh virulent blood they have shown no evil results. Instructed by his partial insuccess, Toussaint extended his method by injecting, not once, but on two successive occasions, the *supposed* devitalized anthrax blood, and he found that this increased the certainty of protection, and by late accounts he had at the veterinary school of Toulouse ten animals, sheep and dogs, which he had in this way rendered insusceptible to inoculation with the most virulent anthrax fluids. In carrying out his method, Toussaint found that not only was a repetition of the injection with the devitalized blood necessary, but that it was needful to allow a certain period (twelve to fifteen days) to elapse between the last injection and the inoculation with anthrax liquids; otherwise the protection was not attained. In short, it was with these injections of devitalized blood as it had been with the inoculations with virulent anthrax liquids practiced by Chauveau. If a new inoculation with virulent anthrax liquids were made while the system was still disordered with the results of the former operation, it only insured a severe or fatal result. To secure good results the febrile condition caused by the injection of the *supposed devitalized* anthrax liquid must have quite disappeared, and time must have been allowed for the elimination of the chemical products of the anthrax, and for producing the full obtainable impression on the living elements of the tissues, before the protecting influence could be relied upon.

A partial failure which befell Toussaint at Alfort deserves to be mentioned. Twenty sheep were injected with the *supposed devitalized* anthrax blood, and within four days four of them died of anthrax, their blood swarming with *bacilli*. Here, unquestionably, there was some lapse. Either the heat had not been sufficient to kill the bacteria in the anthrax liquid, and some active *bacilli* had been injected with the supposed harmless blood, or the anthrax germs had been introduced from some other source and produced the fatal results recorded. Properly viewed, the occurrence does not militate against Toussaint's method. It showed merely that he had employed too low a temperature or for too short a time in devitalizing the anthrax liquids, or that the experiment was so far vitiated by the accidental introduction of other anthrax germs. This will be evident when it is told that of the sixteen remaining sheep of the experimental lot a number have been inoculated with anthrax liquids, but all have resisted their evil influence.

The desideratum in Toussaint's method appears to be the exposure of the virulent liquid to be used for protective purposes to a higher temperature and for a longer time than he has practiced. If the protecting agent is a mere chemical product, as there is reason to believe, there is little danger of its destruction by exposure to 55° C. for a longer period, or even to a considerably higher temperature.

My results.—A pig was injected with one drachm of virulent swine-plague blood which had been repeatedly heated to 130°, 150°, and 200° F., and a month later with an equal amount of virulent blood which had been raised to 130° F. for thirty minutes, and the day following for three hours. This caused some loss of appetite and appearance of ill health, but no very appreciable fever. Thirteen days after the last operation this pig was placed in a small pen with a pig suffering from swine plague, and at intervals of a month was twice inoculated with the virus of swine plague, but all without evil consequence.

Another pig was injected with a drachm of infusion of the mucus-covered fæces of a pig suffering from swine plague, the infusion having first been filtered and heated for one-half an hour to 130° F., until all movement of the contained bacteria had ceased. As in the other case there was some evidence of ill health, but no material fever, and on the thirty-eighth day the subject was placed in a small pen with a sick pig. Afterward, with intervals of a month, it was twice inoculated with virulent (swine plague) virus, but successfully resisted, and maintained good general health.

A third pig was injected with one drachm of pork infusion which had swarmed with bacteria, resulting from an inoculation with infusion of putrid maize. Before inoculating it on the pig the pork infusion was heated to 140° F. for three hours in succession. There resulted some derangement of health, slight fever, and a local swelling in the seat of injection. When these had subsided, on the fourteenth day, the pig was placed in a small pen in company with a diseased one. Nine days after she had a sharp attack of swine plague, which lasted eighteen days, and led to much loss of condition. Later, at intervals of one month, she was twice inoculated with active virus of swine plague, but on each occasion without any further ill result.

On the last occasion of the inoculation of these three pigs a fresh pig was inoculated with the same virulent matter, which caused considerable fever with a temperature varying from 104° to 106° F., but from which the subject finally recovered.

Here, then, we have two pigs protected from the noxious action of the swine-plague virus by being first brought under the influence of the chemical products resulting from the growth of this virus in the system. We have further a third pig treated in the same way with the products of an ordinary putrefaction fermentation in a pork infusion which had been similarly devitalized by heat, but this fails to secure the same immunity, and this pig suffers severely from swine plague when made to cohabit with a victim of that disease. Later, this pig and the two others successfully resist two successive inoculations with swine-plague virus, while a fourth pig inoculated with this same virus sustains a considerable but not a fatal attack.

The experiments, it is true, are limited in number and liable to the objection that the results may have been accidental coincidences, yet so far as they go they support the theory that the chemical product of the swine-plague germ when deprived of its living *microphytes* affects the system so as to render it, for the future, insusceptible to the attacks of such germs. When taken in connection with the fact that swine plague rarely recurs in the same individual, that, as in the case of other diseases that attack the same animal but once, the most rational explanation appears to be that it is the deleterious chemical products of the disease germ and not the germ itself that affects the system so as to secure this immunity, and finally that in the closely-allied disease of anthrax Toussaint has secured a similar insusceptibility by an identical process, it is altogether reasonable to suppose that we are here furnished with a system of prevention which, if carried into general practice, would reduce our present losses from hog cholera to a comparatively insignificant figure.

It is not without hesitancy that I announce this conclusion, but this hesitation arises not so much from uncertainty as to the results as from the fear that if extensively resorted to it will be liable to be widely misapplied and to fall into unmerited discredit.

When it is considered that the term hog cholera is applied to every fatal disease of swine, it is at once seen how this method of preventing hog cholera would be applied to a large class of disorders to which it is in no sense adapted and would soon gain the most unqualified and most undeserved condemnation. One or two examples of the confounding of other affections with the genuine hog cholera may be quoted to illustrate this danger. In the report of the Department of Agriculture for 1877, Dr. Healey describes a so-called hog cholera which prevailed in Princess Anne county, Virginia, but which was due to minute worms embedded in the mucous coats of the stomach and bowels. From the cuts of some of these worms I would judge them to have been the embryos of the whipworms (*Tricocephalus dispar*). Long before Dr. Fletcher, of Indiana, found an epizootic of so-called hog cholera caused by the presence of the lard worm (*Stephanurus dentatus*) in great numbers in the liver. Mr. Hatch, chairman of the Congressional House Committee on Agriculture, recently told me that in his district a Dr. Johnson found the hog cholera (?) to be caused by worms in the lungs and bowels, and has virtually cleansed the district of this disease by the free use of tobacco. I have repeatedly seen a high mortality among pigs from the ravages of the large round worm (*Ascaris suilla*) which crowd the intestines and even block the gall ducts with the most serious and even fatal results. In other cases the presence in numbers of the small round-mouthed worm (*Sclerostonum dentatum*), or of the hook-headed worm (*Echinorynchus gigas*) gives rise to a similar widespread mortality, preceded by intestinal suffering and disorder and emaciation, which is readily mistaken for the genuine hog cholera.

Again, the presence in the bowels of myriads of *trichina spiralis*, and the irritation caused by them in boring through the walls of the intestines, may easily give rise to symptoms that may be taken for those of hog cholera. Now, nothing can be clearer than that our system of prevention applied to those verminous diseases would be utterly futile, and as all of them are spoken of as *hog cholera*, any general resort to the method would inevitably embrace such cases, and as surely bring condemnation on the measure.

Again, so-called hog cholera is sometimes found on investigation to be simple malignant or bacteridian anthrax, freely intercommunicable between different animals, and between these animals and man. In cases of this kind our method would probably protect against the anthrax, but we have as yet no evidence to show that the chemical products of anthrax would prove protective against the *genuine hog cholera*.

In other cases still we find a great mortality among hogs, and especially high-bred hogs, from *tuberculosis*. Here the disease usually attacks the bowels, and the attendant ulcers of their walls, and the enlargement of the mesenteric glands, with the consequent disorder of the digestive organs, abdominal pain, and emaciation, easily lead to the confounding of this disease with the sub-acute types of hog cholera. But there is no reason to suppose that the application of the suggested method of prevention to this disease would be of the slightest avail.

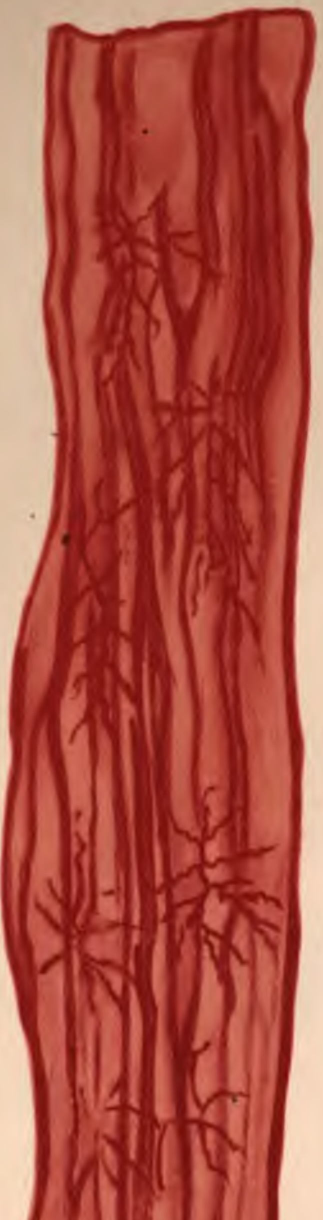
We might go on to enumerate nearly all the fatal diseases of swine,

Report Commissioner of Agriculture for 1880.

SWINE PLAGUE.

Investigations by Dr. James Law.

Plate I.



Mucous Membrane of small Intestine with blood effused on its surface.

A.Hoen & Co. Lithocaustic. Baltimore

but these examples will suffice to show how the method proposed is liable to the grossest abuse in ordinary hands. If fully confirmed by further experiment, and reduced to safety by all necessary precautions, it gives promise of proving a measure of the most beneficent kind, but if applied recklessly, and without due knowledge of the true nature of the existing disease, or due judgment as to method, it may prove far more hurtful than beneficial. From observations already made the following may be set down as among the necessary

PRECAUTIONS TO BE OBSERVED:

1st. See that it is the genuine hog cholera or swine plague that is being dealt with. This is equally necessary as to the disease to be prevented, and as to the virus which is to be devitalized for preventive inoculation.

2d. The virulent fluid to be devitalized may be the blood of a diseased animal, or the liquid exudation into a diseased organ, including the lumen of the bowel. In such cases it is best taken at the height of the disease rather than from a partially convalescent animal in which the virus may have disappeared, and the structural changes only may have been left. If from a cultivation in pork infusion, that should have been prepared with all due precaution against the introduction of air bacteria, and with access to air, but which air should not much exceed one-fifth of its bulk.

3d. In exposing this fluid to heat, that should be carried to 140° F. and retained at this temperature for an hour or more, until, in short, all indications of life in the contained mycrophytes has ceased.

4th. Swine to be operated on must be removed from all diseased hogs and infected places and objects, for with the presence of the living germ in the system the injection of the devitalized chemical products will only tend to aggravate the attack. For the same reason all inoculated animals showing symptoms of a severe attack and presumably suffering from bacteridian infection, in place of the simple intoxication with the chemical products, should be at once removed from the herd operated on.

5th. In inoculating the devitalized chemical products, the injection of a small quantity at a time and its repetition at intervals of three days or a week promises to be safer and more effectual than one large injection. The injection of 10 to 20 drops at a time and its repetition once or twice would probably secure a greater immunity with less loss of condition and progress than if a larger amount were introduced at once.

6th. The animals operated on should be carefully guarded against infection for three weeks after the last injection of the devitalized virus. The presence of the chemical poison in the blood and the attendant constitutional disturbance invites rather than debars the growth of the plague germ; hence the latter must be excluded until the former has been entirely eliminated. For the same reason the free use of disinfectants (chloride of lime, chloride of zinc, sulphate of iron, or carbolic acid) in the operating yards and buildings will be of the utmost value. So will every conceivable precaution against the introduction of disease germs through accidental channels, as by other animals, by the pork stolen by dogs, carried by men, &c.

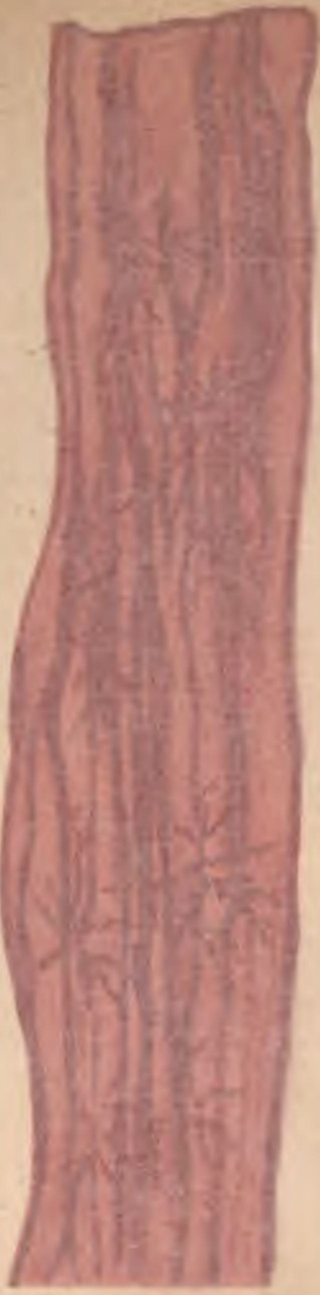
ADVANTAGES PROMISED BY THIS METHOD.

1st. It offers immunity from a fatal disease by a method which does not entail the propagation of the living germ in the system of the animal to be protected.

Report Commissioner of Agriculture for 1880.

SWINE PLAGUE.

Investigations by Dr. James Law. Plate I.



Mucous Membrane of small Intestine with blood effused on its surface

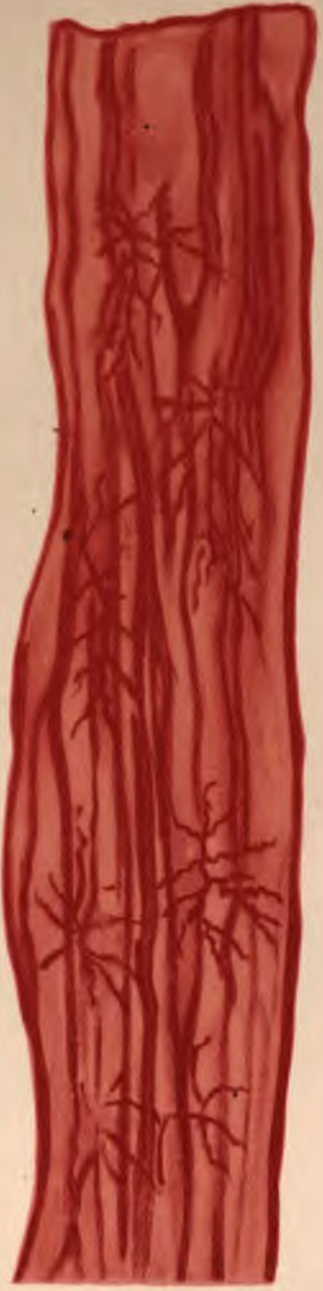
[illegible]

Report Commissioner of Agriculture for 1880.

SWINE PLAGUE.

Investigations by Dr. James Law.

Plate I.



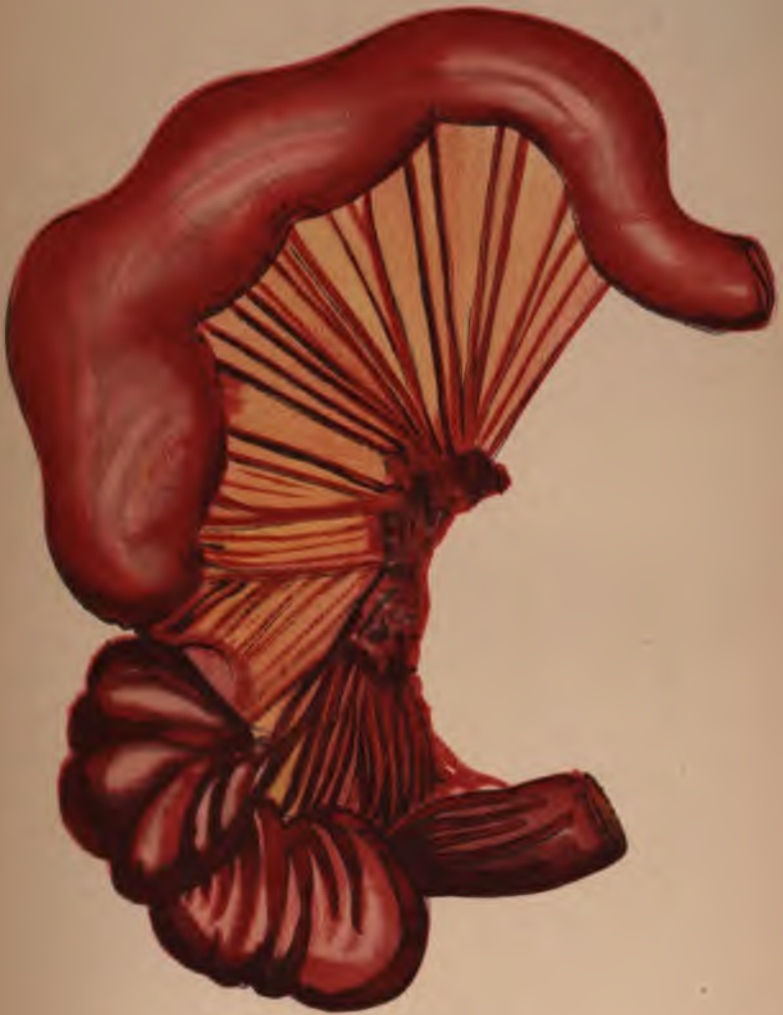
Mucous Membrane of small Intestine with blood effused on its surface.

A.Hoen & Co. Lithocaustic. Baltimore

Report Commissioner of Agriculture for 1880.

SWINE PLAGUE.

Investigations by Dr. James Law. Plate II.



Invagination of small Intestine in white pig No. 4, which died Sept. 29. 1880. Shows whole intestine and mesentery violently inflamed and blood effused into the lumen.

A. Hoen & Co. Lithocaustic. Baltimore.

Report Commissioner of Agriculture for 1880.

SWINE PLAGUE.

Investigations by Dr. James Law.

Plate III.

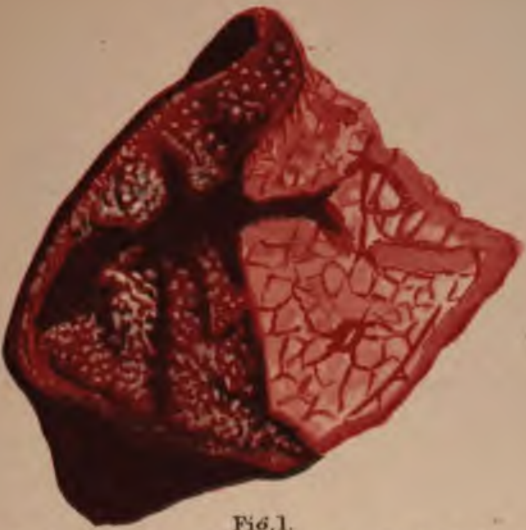


Fig. 1.

Portion of Right Lung of small white pig No. 5, which died Oct. 12, 1880. Dark part of parenchyma is consolidated and studded with miliary tubercles.

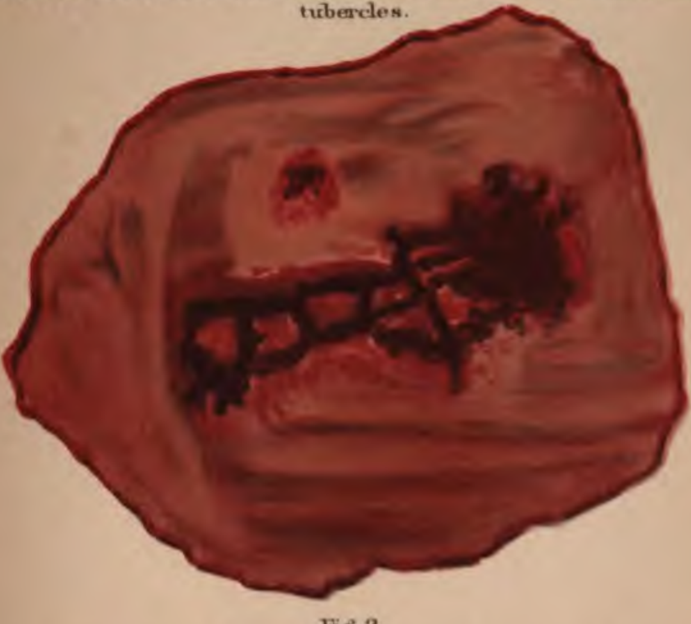


Fig. 2.

Portion of mucous membrane from the Great Curvature of the stomach of the same pig. General congestion, with patches of blood extravasation and erosion.

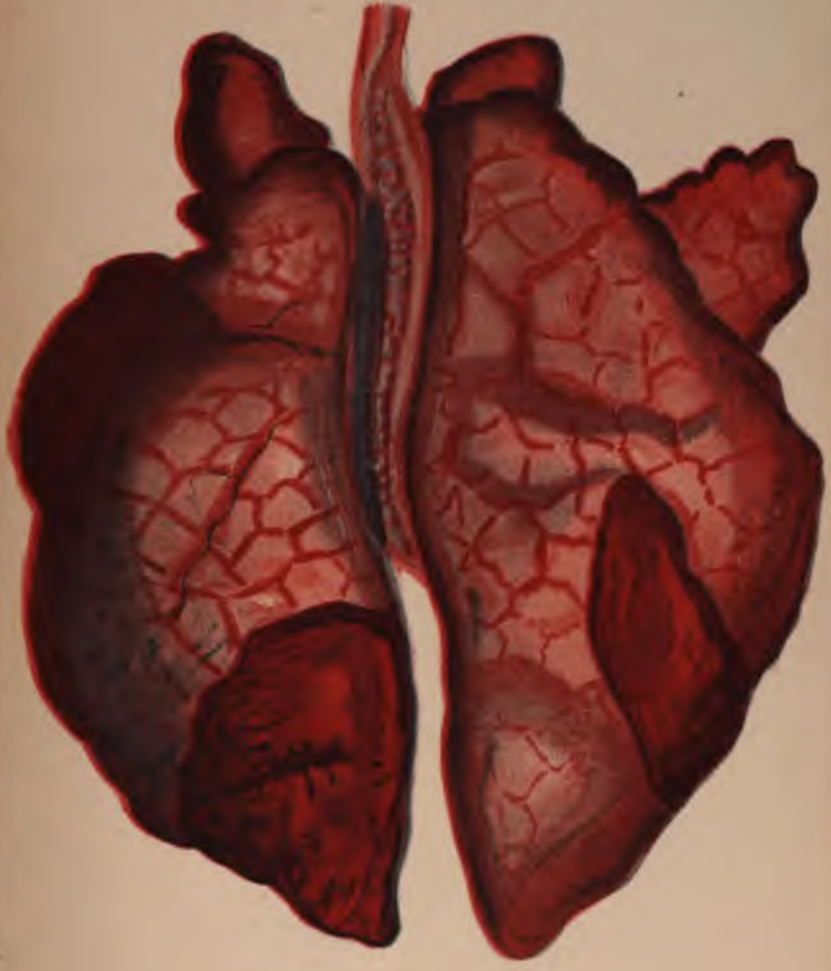
A. Hoen & Co. Lithocaustic. Baltimore.

Report Commissioner of Agriculture for 1880.

SWINE PLAGUE

Investigations by Dr. James Law.

Plate IV.



Lungs of large white pig No. 9, which died Oct. 9, 1880. Hepatised portions stand out clearly by margins of lobules.

A. Hoen & Co. Lithocaustic. Baltimore.

Report Commissioner of Agriculture for 1880.

SWINE PLAGUE.

Investigations by Dr. James Law. Plate V.

Fig 1.

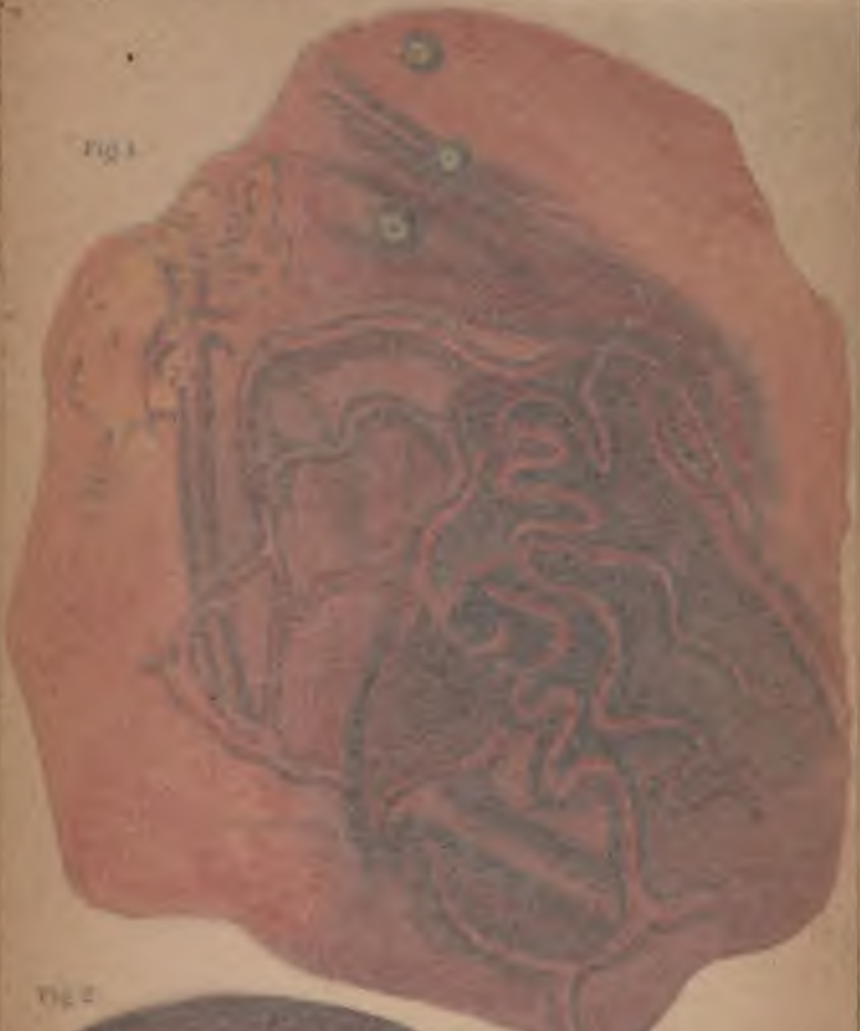


Fig 2.

Fig 1.

Mucous membrane of lesser Curvature of pig No. 9, died Oct 9, 1880. The dark congested ridges correspond to the curvature; the circular ulcers and yellow diphtheritic false membrane are on the pyloric side.

Fig 2.

Kidney of same pig.

A. Hoen & Co. Lithocaustic, Baltimore.

Report Commissioner of Agriculture for 1880.

SWINE PLAGUE.

Investigations by Dr. James Law. Plate V.

Fig. 1.

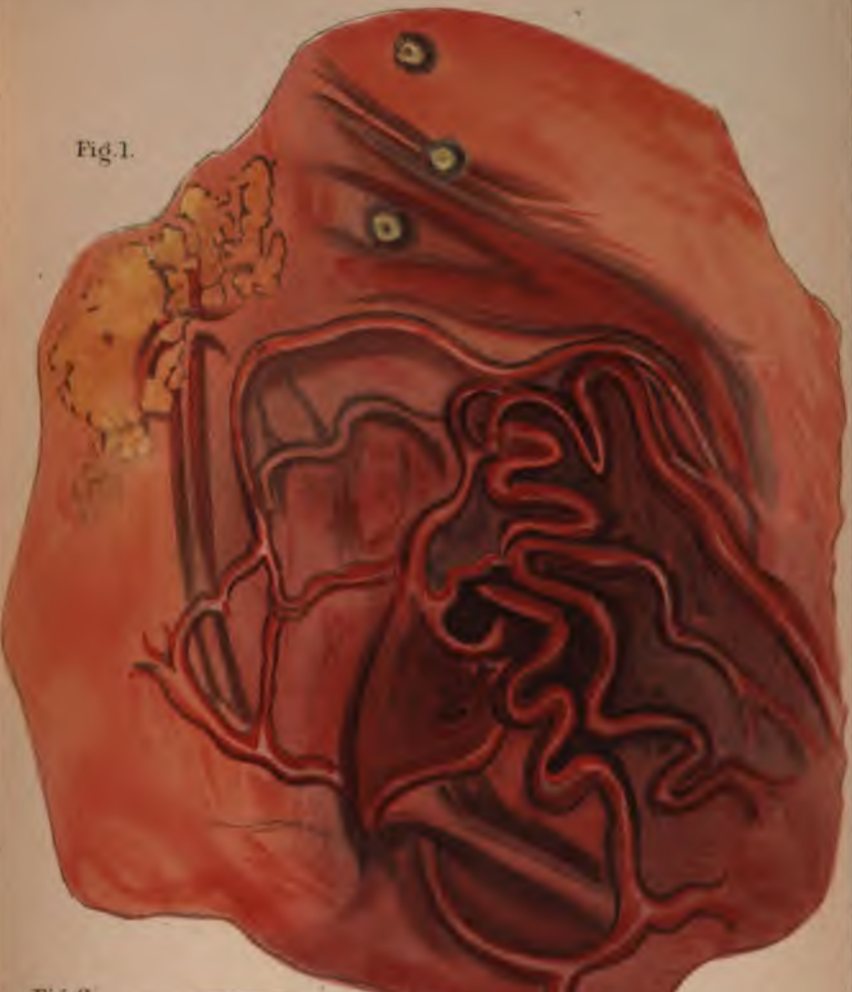


Fig. 2.

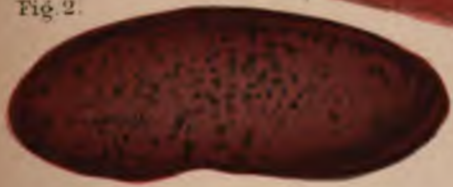


Fig. 1.

Mucous surface of Great Curvature of pig No. 9, died Oct. 9, 1880. The dark congested rugæ correspond to the curvature: the circular ulcers and yellowish false membrane are on the pyloric side.

Fig. 2.

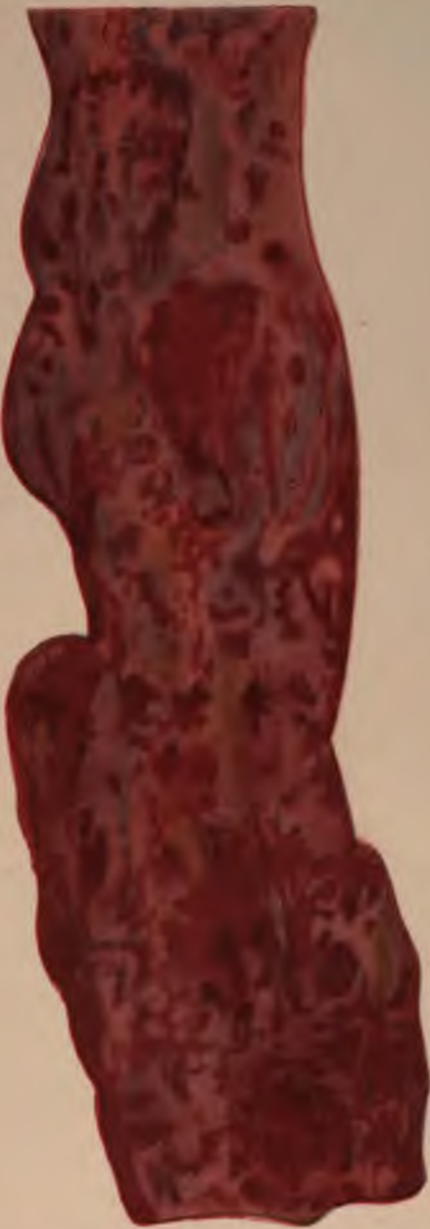
Kidney of same pig.

A. Hoen & Co. Lithocaustic, Baltimore.

Report Commissioner of Agriculture for 1880.

SWINE PLAGUE.

Investigations by Dr. James Law. Plate VI.



Mucous surface of Rectum of pig No. 9, which died Oct. 9, 1880.

Report Commissioner of Agriculture for 1880.

SWINE PLAGUE.

Investigations by Dr. James Law. Plate VII.

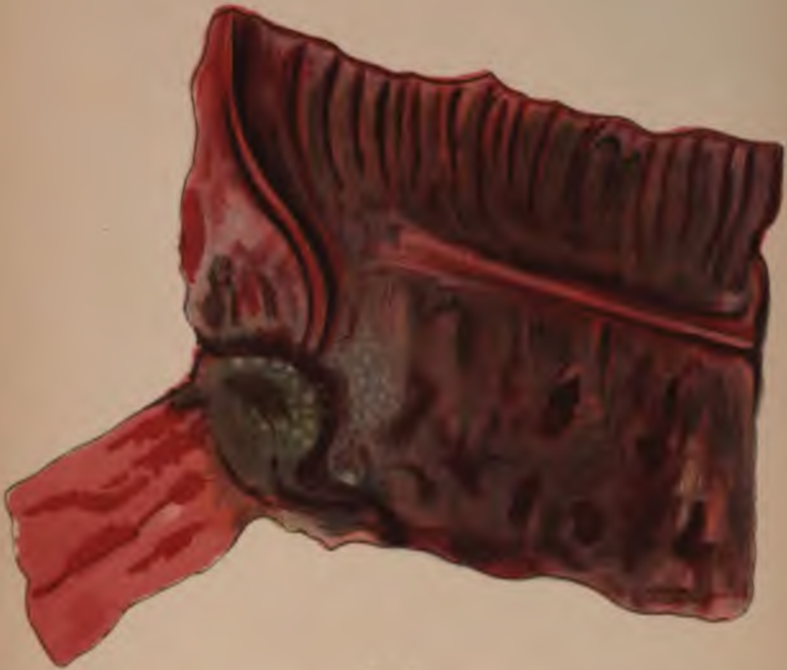


Fig. 1.
Ilio-cæcal valve and portion of cæcum of pig No. 9, which died Oct. 9, 1880.

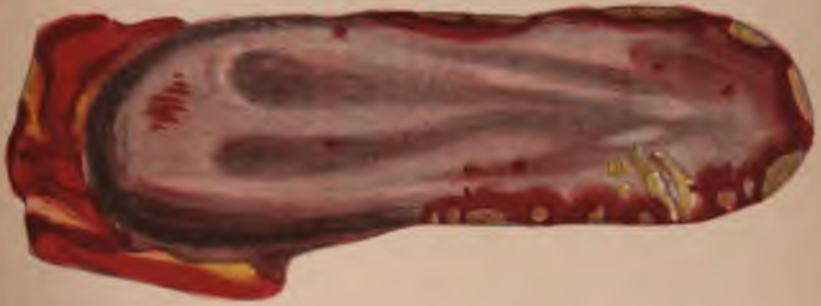


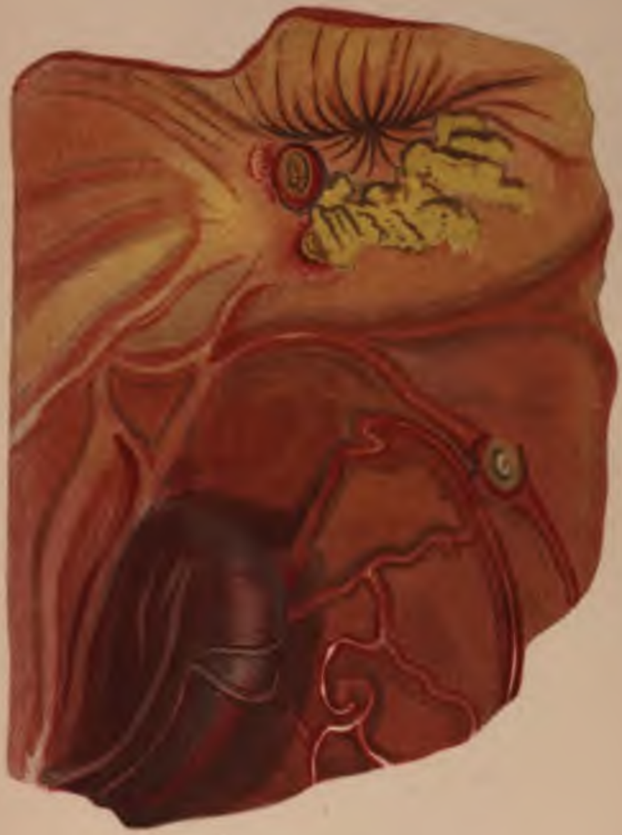
Fig. 2.
Tongue of small white pig No. 10, which died Oct. 12, 1880. Shows numerous ulcers and petechiæ.

A.Hoen & Co. Lithocaustic, Baltimore.

Report Commissioner of Agriculture for 1880.

SWINE PLAGUE.

Investigations by Dr. James Law. Plate VIII.

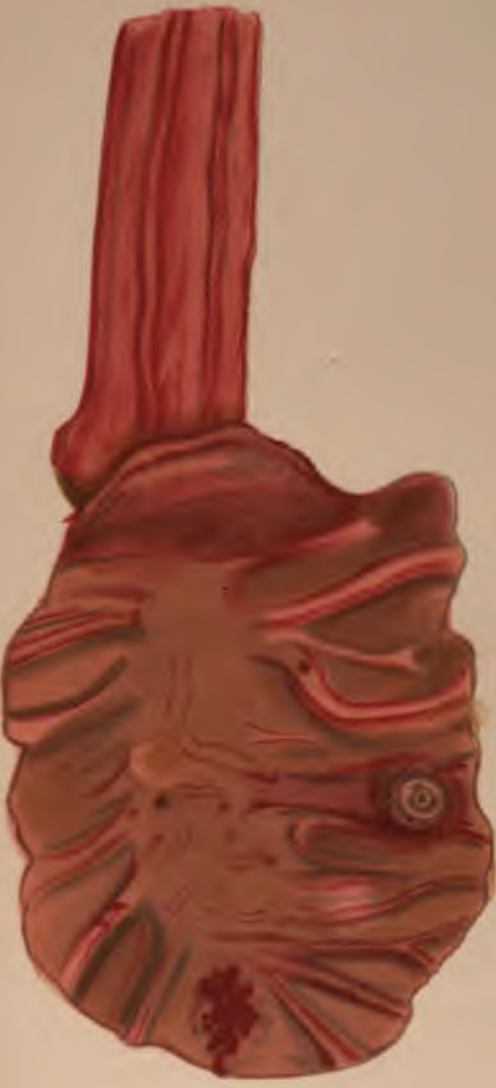


Portion of stomach of small white pig No.10. which died Oct.12,1880.
The dark congested portion on the Great Curvature; the ulcers and false membranes near the pylorus.

Report Commissioner of Agriculture for 1880.

SWINE PLAGUE.

Investigations by Dr. James Law. Plate IX.



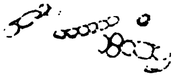
Ilio-caecal valve and part of caecum of small white pig No. 10, which died Oct. 12. 1880. Caecum shows a circular ulcer and various erosions.

Report Commissioner of Agriculture for 1880.

SWINE PLAGUE.

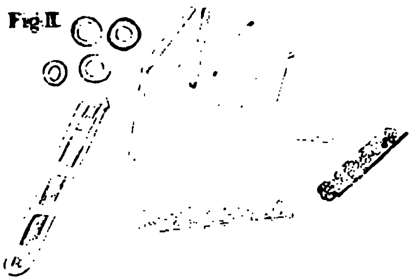
Microscopic Investigations by Dr. James Law.

Fig. I.



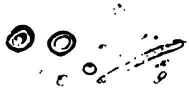
Bacteria from the lung exudate of sick pig killed June 23, 1880, at Horseheads. Hartnack No 10. Immersion. Tube lengthened.

Fig. II.



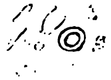
From the milk tank for the piggery, where the sick pigs were kept.
Hartnack No. 10. Tube drawn out.

Fig. III.



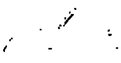
Milk, whey, &c. from feeding trough of the piggery. The bacteria have lively movements. Bacteria and Oil globules.
Hartnack No 10. Immersion.

Fig. IV.



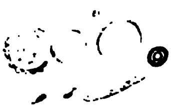
Bacteria cell and granules from liquids of inoculation swelling of No 2, Aug 13, 1880.
Hartnack No 10. Immersion.

Fig. V.



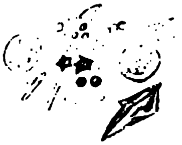
Bacteria in egg albumen inoculated six days before and kept at ordinary temperature in July.
Hartnack No. 10. Immersion.

Fig. VI.



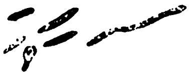
Blood globules and bacteria from virulent blood sent in vacuum tube from North Carolina.
Hartnack No. 10. Immersion.

Fig. VII.



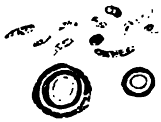
Objects seen in the pus of inoculation abscess of No. 4. x 250.

Fig. VIII.



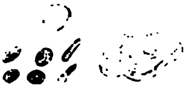
Bacteria in urine of man inoculated with virus of Swine Plague, seven days before, and kept in apparatus closed by cotten wool at ordinary temperature in July. Motions lively.
Hartnack No. 10. Immersion.

Fig. IX.



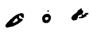
Bacteria from milk inoculated with hog cholera 48 hours before. Second generation. Hartnack No. 10. Immersion.

Fig. X.



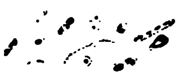
Bacteria &c. from egg albumen inoculated three days before with Swine Plague virus and kept in apparatus at ordinary July temperature. No motion.
Hartnack No 10. Immersion.

Fig. XI.



Bacteria found in the urine of pig No. 1 just after death July 17, 1880. Lively movements.
Hartnack No 10. Immersion.

Fig. XII.



Bacteria from the blood of dead pig No 9. Lively movements.
Hartnack No 10. Immersion.

A. Hoen & Co. [illegible]

2d. It avoids the risk of the preservation, amplification, diffusion, or increase of potency of the disease germ, all of which contingencies are possible in inoculations with a mitigated virus.

3d. It does away with the necessity for an exhaustive disinfection after the animals have been inocculated and have recovered from its results.

4th. The dose of the devitalized chemical products can be so graduated to the strength of the animal that there will be no risk of a fatal result. When even the mitigated living germ is introduced there can no longer be any certainty that it will not reproduce itself to a dangerous extent, or that owing to the special condition of the system or of its surroundings it may not suddenly assume its fatal type, but with the devitalized chemical products we can graduate the dose so as to secure as great a certainty in result as in the case of a dose of castor oil or Epsom salts.

5th. The system can be habituated to the poison and fortified against it by a succession of small doses, no one of which is at all dangerous in itself, whereas if a germ were once introduced, though of mitigated power, it may increase so as to develop a power that is altogether unexpected.

DISADVANTAGES AND DRAWBACKS.

These are few, apart from the certainty above noticed, that if largely resorted to it will be misapplied by many to other diseases than the genuine swine plague, and will thus fall into disrepute.

It can do no good but only harm to animals that are already infected, as it can only add to the deleterious products with which the germ is charging the system.

Its effect can only be evil if the subjects are allowed to become infected before the chemical products of the bacteria have had time to fully affect the system and to have become eliminated. If this is neglected, and early infection is allowed, it can only add to the mortality.

There is the additional disadvantage that to secure the protective products the production of the virulent germ must be kept up, either in the bodies of a successive series of diseased pigs or in an infusion of pork. The slightest carelessness with regard to the seclusion of these fields of poison, or as to the disposal of their products, may easily become the occasion of a spread of the worst type of the plague among unprotected animals.

On the whole these drawbacks can easily be guarded against, and it may well be hoped that in the hands of scientific men, who will not blunder at the outset as to the nature of the disease in hand, this method of protection may be availed of to reduce to the minimum our losses from hog cholera.

EXPERIMENTS IN INOCULATION WITH THE BLOOD OF A SUFFOCATED PIG.

In view of the observation of Signol that the blood of the portal vein of a suffocated horse was virulent when inoculated on other horses, and produced a disease that could be conveyed indefinitely from horse to horse, and the physiological fact that the hog demands an unusual amount of air in proportion to his size, I sought to resolve the question as to whether the swine plague could be produced by the modification of intestinal bacteria grown in the circulating blood, which had been largely deprived of air.

A four-weeks old Berkshire pig was taken from its dam and fed for two days on Indian corn meal and wheat bran. It was then killed by suffocation, and one hour later ten drops of blood from the *rete mirabile* of the small intestines were mixed with a drachm of river water and injected into the right flank of a four-months old Berkshire pig. This pig had on the fifth day a material rise of temperature, which continued for seven days, but there was no manifest dullness, loss of appetite, nor other very marked sign of illness. Three weeks after this pig was inoculated with the virulent intestinal contents of a sick pig, and again after six weeks more with virus cultivated in pork infusion with a limited supply of air, but suffered no marked impairment of health from either operation. It was also kept in an infected pen without any evil result.

A second four-months old Berkshire was inoculated with the portal blood of the suffocated pig—in this case ten hours after the death of the latter. The same amount of blood was used, having been mixed with half a drachm of water and thrown into the subcutaneous tissue of the left flank. In this pig also the temperature was elevated on the fifth day, and the high temperature lasted for five days, but as in the other case there was no serious evidence of ill health. As in the other case, this pig was twice thereafter inoculated with virulent matter without any evident harm.

I hardly dare to attach any importance to these results. The very slight impairment of health caused by inoculation with the blood of the suffocated pig, and the absence of all specific swine-plague lesions in the animals operated on, militates against the idea that they suffered from this disease. On the other hand, the fact that the second and third inoculations made with virulent matter had no apparent effect upon them, but that the last (February —) had a decided effect on a fresh and unprotected pig, might be held to imply that the first inoculation—that, namely, with the blood of the suffocated pig—had protected them against the inroads of the swine-plague poison. Such a protection would not be altogether unprecedented, as Pasteur found that his chickens inoculated with the mitigated virus of chicken cholera, were fortified not against that disease only, but against anthrax as well—a bacteridian affection, but one which seems to depend on an altogether different germ from that of chicken cholera.. That the result thus obtained by Pasteur is not a principle capable of general application is shown by the result of my inoculation with the products of a fermentation in pork infusion inoculated from a fermenting infusion of maize, the pig thus inoculated having afterward had a sharp attack of swine plague when subjected to that infection.

We see that in certain cases the chemical products of the growth of one bacterium will affect an animal system so as to fortify it against the attacks of another bacterium, but also that this does not hold as between all the different bacteria fermentations, the products of one having no protective effect on the system against the attacks of certain others. It seems preferable, therefore, to leave the bare facts stated as they have been observed. They may serve as a suggestion for further experiment in this direction until the present indications shall have been otherwise explained, or, if they really bear out the theory I set out to test, until the protective action shall have been placed on a solid foundation.

Respectfully submitted.

JAMES LAW.

ITHACA, N. Y., *March* 14, 1881.

RECORD OF DR. LAW'S LATER EXPERIMENTS.

SMALL WHITE PIG NO. 11.

	Temperature.		Remarks.
	Morning.	Evening.	
1880.	°	°	
Oct. 11	....	....	Inoculated by injecting one drachm of the blood of No. 9, which had been first heated to 130°, 150°, and 200° F., on successive occasions, and two drops of carbolic acid added.
12	....	102	
13	102	103	
14	102	102.5	
15	102.5	102.5	
16	101.5	101.5	
17	101.5	102	
18	102	103	
19	101.5	102	
20	101	101.5	
21	101.5	103.75	
22	102	103	
23	101.5	102.5	
24	102.5	102.75	
25	102	103	
26	103.5	102.5	
27	101	101.5	
28	101.25	101.5	
29	101.5	102	
30	102	103	
31	102	102.75	
Nov. 1	102.75	103	
2	103	102.75	
3	102	102	
4	103	102.5	
5	101.5	102	
6	101.5	102.75	
7	101.5	102	
8	101	101.5	
9	101	101.5	
10	100.5	101	
11	100	101	
12	100.5	101	
13	101	102	
14	101.5	102.5	
15	100	101	
16	100	100	
17	100	102	
18	100	101.25	
19	101.25	102	
20	100	100	Injected one drachm blood serum from No 8. Blood has stood as firm clot since November 1, and was heated to 130° F., for thirty minutes, November 19, and again for three hours November 20.
21	100	101	
22	100	101.5	
23	101	101.75	No local swelling where injected.
24	102	103	
25	101	102	
26	101	101	
27	101	102	
28	101.5	102	
29	101	101.5	Keeps lively, well, and fat.
30	101	101.75	
Dec. 1	102	102	
2	101	102	
3	101.5	102	Placed in small pen with sick pig No. 13.
1880.	°	°	
Dec. 4	102.75	103.5	
5	103	102.75	
6	101.2	101	
7	102	103	
8	101.75	102.5	
9	101.75	102.75	
10	101.5	102	
11	101.75	103	
12	101.75	102.5	
13	102	102.5	
14	103.5	100	
15	103	102.5	
16	102	102.25	
17	102	102.5	
18	103	103	
19	100	101	
20	101	101.75	
21	101.5	103.5	
22	101.5	102.75	
23	102.25	101	
24	100	103	
25	100.75	102.25	
26	101	102.5	
27	100.75	102	
28	101	102.25	
29	100.5	101.5	
30	100	101	
31	100	101	
1881.			
Jan. 1	100	101	
2	100.5	102	
3	101	102.25	
4	102	102.25	Inoculated in tail with virulent matter from intestine of sick pig sent from Michigan, in a quill with ends waxed.
5	101	101.5	
6	100	101	Off feed; gets thin.
7	101	101.5	Do.
8	100	100	Feeds well.
9	100	100	
10	100	100	
11	100	100.2	
12	100	100.2	
13	100	100	
14	100	100.25	
15	100	100.5	
16	100	101	
17	100	101	
18	100	100.5	
19	100.5	101	
20	100	100.5	
21	100.2	101	
22	100.2	100	
23	100	101.5	
24	100.5	101	
25	100	101	
26	100.5	100.2	
27	100.2	101	
28	101	....	
29	101	....	
30	101	....	
31	101	....	
Feb. 1	100.5	....	
2	100.75	....	
3	100.5	....	
4	100.25	....	
5	101	....	
6	100.5	....	

RECORD OF DR. LAW'S LATER EXPERIMENTS—Continued.

SMALL WHITE PIG No. 11—Continued.

	Temperature.		Remarks.
	Morning.	Evening.	
1881.	°	°	
Dec. 7	100.25	....	
8	100.5	....	
9	100.25	....	
10	100	....	
11	101	....	
12	101	....	
13	101.5	....	
1881.	°	°	
Feb. 14	....	....	Inoculated with pork infusion inoculated with virus sent from Michigan, and cultivated with a very limited amount of air.

From this time up to March 9 the temperature varied from 101° to 103°; the appetite remained excellent and the subject gained rapidly in condition.

SMALL WHITE PIG No. 12.

	Body temperature.		*Remarks.
	Morning.	Evening.	
1880.	°	°	
Oct. 18	....	103	
19	102	103	
20	102.5	103	
21	102.75	103.75	
22	103	102.75	
23	101	102.5	
24	101.75	102.5	
25	101.75	102.75	
26	102.75	103	
27	103	103.25	
28	100	100.5	
29	101	103.25	Injected hypodermically one drachm of infusion of hard mucous feces from sick pig No. 8, having first filtered the liquid and heated to 131° F. for thirty minutes.
30	102	103.5	
31	101.75	102	
Nov. 1	101.5	102	
2	102	102.75	
3	101.5	102	
4	101.5	102	
5	102	102.5	
6	103	103.25	
7	102	103	
8	101.5	102	
9	101.5	101.75	
10	101	101.5	
11	101	101.75	
12	101.5	101.75	
13	101.5	102	
14	101.5	102	
15	100	101	
16	100.5	101	
17	101	102	
18	101.5	102.5	
19	102.25	102.5	
20	100	100	
21	100	101	
22	102	103	
23	103	104	Appears in rut.
24	102	103	
25	100	100	
1880.	°	°	
Nov. 26	103	104	
27	103	103	
28	102.75	103	
29	102	102	
30	102	103	
Dec. 1	102	103	
2	101	103	
3	103.5	104	
4	104.25	103.75	Placed in pen with sick pig No. 13.
5	103.5	104.5	
6	103	103	
7	102.5	102.75	
8	102.25	102.75	
9	102.5	102.75	
10	102	102.75	
11	102	102.75	
12	102.25	103	
13	102.5	103.5	
14	103.25	102.5	
15	102.5	103	
16	103	102	
17	102.5	102.75	
18	102.5	103	
19	102.5	103	
20	102.5	103.25	
21	102.5	103	
22	102	103	
23	100	102.5	
24	102	103.5	
25	102	102.75	
26	102	102.5	
27	102.25	103	
28	101.75	103	
29	102.5	103	
30	100	100.5	
31	100	100.5	
1881.			
Jan. 1	101	102	
2	101.5	102.5	
3	102	103	
4	102.5	103	Inoculated with matter from intestine of diseased pig, sent from Michigan in quill with ends waxed.

SMALL WHITE PIG NO. 12—Continued.

	Body temperature.		Remarks.
	Morning.	Evening.	
1881.	°	°	
Jan. 5	102	102.5	
6	102	102	
7	102	102.5	
8	102.5	102.5	
9	101	102	
10	101	102.25	
11	....	102.25	
12	....	102	
13	....	102	
14	....	102.25	
15	....	102	
16	....	102.5	
17	....	102	
18	....	102.25	
19	....	102	
20	....	102	
21	....	102.25	
22	....	102	
23	....	102.25	
24	....	102	
25	....	101.5	
26	....	101.75	
27	....	102	
28	....	102	
29	....	102.2	
30	....	101.75	
1881.	°	°	
Jan. 31	....	102	
Feb. 1	....	102	
2	....	102.25	
3	....	102.5	
4	....	102	
5	....	102	
6	....	102.25	
7	....	102	
8	....	101.75	
9	....	101.5	
10	....	102	
11	....	102	
12	101.75	101.75	
13	....	102	
14	....	....	Inoculated with pork infusion which had been inoculated with infecting matter from sick pig. From this time up to March 9 it maintained the same average temperature as above, and fed well and improved in condition.

SMALL WHITE PIG, NO. 13.

	Body temperature.		Remarks.
	Morning.	Evening.	
1880.	°	°	
Oct. 18	....	102	
19	102	103	
20	100	101.5	
21	102	103.75	
22	102	103	Inoculated with one drachm pork infusion, filled with bacteria, from having been infected from infusion of putrid maize. Infusion heated to 140° for 45 minutes before it was inoculated.
23	102	102.5	
24	101	102	Slight swelling in the seat of inoculation.
25	102	103	
26	103.5	103.5	Swelling has disappeared.
27	101	101.5	
28	101.5	102.5	
29	102	103	
30	102.5	103	
31	100	101	
Nov. 1	100.25	101.5	
2	101	102.5	
3	101.5	103	
4	102	103	Placed in pen with sick pig No. 10. Present Report.
5	102.5	103.5	
6	102.5	102.75	
1880.	°	°	
Dec. 6	102.75	103.5	Freezing.
7	102.5	103	Cold.
8	102.75	103.25	Do.
9	102.5	103	Very cold.
10	102.75	103.25	Below zero. Appetite gains.
11	101.75	102.75	Very cold.
12	101	102	Thaw—rain.
13	101.5	102.75	Do.
14	103	103	Mild.
15	103	103.25	Freezing.
16	103	103.25	
17	102.75	103.25	
18	99	101	Cold intense. Appetite good.
19	100	102.5	Cold intense.
20	101.75	102.25	
21	102	102.75	
22	102	102.5	
23	100.5	102.75	
24	102.5	103	
25	102	103	
26	102.25	103	
27	102.5	103.25	
28	102.5	103.5	
29	103.5	103.5	
30	100	102	Temperature 14°.
31	100	102.75	Still below zero.
1881.			
Jan. 1	102.75	104	
2	103	103.5	Mild.
3	102	103	

SMALL WHITE PIG NO. 13—Continued.

	Body temperature.		Remarks.		Body temperature.		Remarks.
	Morning.	Evening.			Morning.	Evening.	
1880.	°	°		1881.	°	°	
Nov. 7	102.5	103		Jan. 4	102	103	Inoculated with infecting bowel products from Michigan, sent in a sealed quill; $\frac{1}{16}$ grains used.
8	102	102.75		5	102	102.5	
9	102.5	103		6	102	102 .	
10	103	103.5		7	102	102.5	Thriving.
11	102.5	103.5		8	102	102.5	
12	102	103.25		9	101.5	102	Raw—cold.
13	103	103.5		10	101	103	Snow-storm.
14	103.25	104		11	103	....	
15	103	103.5	Feeds poorly: black unctuous exudation on skin.	12	102.5	....	
16	103.5	104		13	102.75	....	
17	103	104		14	102.25	....	
18	103.5	103.75		15	102	....	
19	103	103.25	An inch of the margin of each ear blue.	16	102.25	....	
20	103	103		17	102	....	
21	103	103		18	102	....	
22	102	103		19	102	....	
23	102	102		20	102.25	....	
24	99	99		21	102.25	....	
25	100	102		22	102	....	
26	101	102		23	102	....	
27	102	102.5	More lively. Feces still fetid.	24	102	....	
28	102.5	103.5		25	102.25	....	
29	103.75	105		26	102.5	....	
80	102	102		27	102	....	
Dec. 1	102	102		28	102	....	
2	102.5	104		29	102.25	....	
3	105	105		30	102.25	....	
4	103.5	102		81	102	....	
5	102.5	103	Thaw with rain.				

From this time the health continued excellent, though the subject was again inoculated February 14 with virus cultivated in pork infusion with a limited amount of air.

SMALL MALE BERKSHIRE PIG, NO. 14.

This subject I acquired a fortnight after I had, by your instructions, suspended work for the Department of Agriculture, but as it was employed as a test case it is important to my conclusions that it should be introduced into this report.

February 14, 1881, it was inoculated with virus that had been cultivated in pork infusion with a very limited supply of air (the same virus used on Nos. 11, 12, 13, 15, and 16). The result was a very material rise of temperature which stood at 104° F. February 18, 105.25° February 21, and 106° for nearly a week thereafter. The appetite fell off somewhat, the inguinal glands were enlarged, the skin became scurfy and slightly unctuous, and he fell off slightly in condition.

The attack terminated in recovery, but was very valuable as showing the marked effect on an unprotected system of the poison which proved utterly harmless to the four protected pigs mentioned above.

FEMALE BERKSHIRE PIG, FOUR MONTHS OLD, NO. 15.

	Temperature of body.		Remarks.		Temperature of body.		Remarks.
	Morning.	Evening.			Morning.	Evening.	
1880.	°	°		1881.	°	°	
Dec. 11	103	103.5		Jan. 5	103	103.5	
12	103	103.75		6	103.5	104	Slightly off feed.
13	103	103.5	Injected into the left flank ten drops of the blood of the portal vein of a pig suffocated one hour before. The injected blood was diluted in one drachm of water.	7	103.5	104	
				8	103.5	103.5	
				9	102.75	102.75	
				10	102.75	103.25	
				11	103.25	....	
				12	103	....	
				13	103.25	....	
				14	103.5	....	
14	104.5	104.5					
15	103.5	103.5					
16	103.5	103.75	Cold.				
17	103.5	104	Very cold.				
18	104	104.5					
19	104.5	105.5					
20	104.5	105					
21	104	104.5					
22	104	104.5					
23	103.25	103.25					
24	102.5	103.5		15	103.5	....	
25	103	105.5		16	103.25	....	
26	104	105		17	103.5	....	
27	103.75	105		18	103	....	
28	103.5	104.5		19	103	....	
29	103.5	103.75		20	103.25	....	
30	103	103.5	Temperature, 14°.	21	103.5	....	
31	102	103.5	Still below zero.	22	103.25	....	
1881.				23	103.25	....	
Jan. 1	102	103		24	103.25	....	
2	102	103.5		25	103.5	....	
3	102.5	104		26	103	....	
4	103.5	104	Inoculated with virulent intestinal contents sent from Michigan in a sealed quill.	27	102.75	....	
				28	102.75	....	
				29	102.5	....	
				30	102.75	....	
				31	102.75	....	

February 14, this pig was inoculated with virulent pork infusion cultivated with a very limited supply of air, but alike before and after the inoculation the temperature maintained about the average of the last few weeks above recorded.

FEMALE BERKSHIRE PIG, FOUR MONTHS OLD, NO. 16.

	Body temperature.		Remarks.		Body temperature.		Remarks.
	Morning.	Evening.			Morning.	Evening.	
1880.	°	°		1881.	°	°	
Dec. 11	103	103.5		Jan. 7	103.5	104	
12	103	103.75		8	103.5	103.5	
13	103.5	103.75	Inoculated with blood of the portal vein of a pig suffocated ten hours ago. About ten drops of blood were mixed with one-half drachm of water and injected.	9	103.5	103.5	
				10	103	103.25	
				11	103.5	....	
				12	103.25	....	
				13	103.25	....	
				14	103.25	....	
14	104.5	104					
15	103	103.25					
16	103.25	103.5					
17	103	103.5					
18	103	104.5	Very cold.				
19	104	105	Do.				
20	104	105	Calm.				
21	104.5	105					

FEMALE BERKSHIRE PIG, FOUR MONTHS OLD, No. 16—Continued.

	Body temperature.		Remarks.		Body temperature.		Remarks.
	Morning.	Evening.			Morning.	Evening.	
1880.	°	°		1881.	°	°	
Dec. 22	104.25	104.75		Jan. 15	103	....	
23	104	103		16	103.25	....	
24	103	103.5		17	103.75	....	
25	103.75	105		18	103.25	....	
26	104	105		19	103.5	....	
27	103.75	104.75		20	103.5	....	
28	103.75	105		21	103.75	....	
29	104.5	105		22	103.5	....	
30	104	104	Temperature 14°.	23	103.25	....	
31	103.5	104	Still below zero.	24	103.25	....	
1881.				25	103.25	....	
Jan. 1	102	102.5		26	103.5	....	
2	103	104		27	103.25	....	
3	103.5	104.5		28	103	....	
4	104.5	104.5		29	103.25	....	
5	104	104		30	103	....	
6	103.75	104	Inoculated with infecting contents of bowel sent from Michigan in a sealed quill.	31	103	....	

February 14, this pig was again inoculated with a cultivation of swine-plague virus in pork infusion wth a limited amount of air, but the health continued unaffected, and the temperature as in the last few weeks recorded above.

INVESTIGATION OF SWINE-PLAGUE.

Third Report of Dr. H. J. Detmers.

Hon. WILLIAM G. LE DUC,
Commissioner of Agriculture:

SIR: In presenting to you the present report and the results of my investigation of swine-plague from April, 1880, till date, permit me to make a few remarks, by way of preface, before I enter into my subject. In my previous investigations, commencing in August, 1878, and continuing with some interruptions till March, 1880, I endeavored first to ascertain the nature and the cause or causes of the disease, the means and manner of its spreading, and the working of its morbid process; and, secondly, to discover the means necessary to check its spreading and to prevent its outbreak. In my present investigation, which may be considered as a continuation of my former work, I made it a special object, first, to verify the results of my former experiments; secondly, to learn the most practical means of prevention, that is, such as would most likely be the least objectionable to the farmer, and prove both effective and easy of application; thirdly, to ascertain whether and to what extent an attack of swine-plague terminating in recovery is able to destroy further predisposition or to produce immunity from the effect of a subsequent infection; fourthly, to study as much as possible the nature, characteristic properties, or features and workings of those schizomycetes (Naegeli) or schizophytæ (micrococci and bacteria) which constitute the infectious principle and the cause of swine-plague; and, fifthly, to ascertain, if possible, the influences or causes which made the disease more lenient or less malignant in 1879 and 1880 than in 1878; in other words, to discover the agencies or conditions which cause the disease to be more lenient in its single attacks, and in its epizootic spreading in one season and in one locality than in another. Whether and how far I have succeeded in solving these problems is not for me to say.

The following pages will show what has been accomplished, and what yet remains to be done. That more might have been done, if circumstances had been favorable, I admit. When I commenced my first investigation, in the fall of 1878 and in the winter of 1878–'79, I had clear sailing, because an abundance of material was always available. The disease presented itself almost everywhere, in its most malignant form. This last year it was not so; material, that is, material from a malignant case, was often wanting when needed, and usually had to be obtained from a great distance. Sporadic outbreaks of swine-plague were numerous enough, but the cases, being invariably very mild, could not be relied upon to furnish material for experimentation, because it was found, this season as well as last year, that an inoculation with infectious material from a very mild case produces, as a rule, only a mild attack. Hence, as it was my intention to find reliable means of prevention, and to subject the preventives used last year to a severe test, it was not advisable to inoculate from any case of swine-plague that presented itself or was convenient. I had to make my selections, and very often was obliged to travel a considerable distance to obtain suitable inoculation-matter from a really malignant and typical case of swine-plague. Whenever it was possible to get material from a malignant and typical case, any other was rejected; and so some time was lost in finding malignant cases; but the results of my experiments have gained in reliability. I preferred to lose some time rather than to make experiments which cannot be relied upon and are apt to mislead or to conceal the truth which we endeavor to ascertain. I have also been very careful never to use any material for purposes of inoculation that was tainted with putrefaction, and, consequently, am sure that I have never mistaken septicæmia or pyæmia for swine-plague; neither do I consider any morbid changes as those of genuine swine-plague, unless the peculiar changes (hepatization) in the lungs, characteristic of that disease, are fully and unmistakably developed. For purposes of inoculation I have always chosen material, whenever I had a choice, from animals in which not only the lungs, but also the intestines, the cæcum and colon, or one of them, exhibited in a fully-developed form the characteristic morbid changes—the lungs the peculiar hepatization, and the cæcum and colon the ulcerous tumors. Further, I never used material except from animals of which I myself made the post-mortem examination, and, whenever obtainable, took it from pigs killed by bleeding while in an advanced stage of swine-plague. Whenever such an animal was not available, and I was therefore obliged to take the material from a dead pig, it was always taken from one that had been dead but a very short time—an hour or two—and in which putrefaction was not noticeable. Further, no material was used for inoculation that had not been subjected to a thorough microscopical examination, and found free from bacterium termo at the time the inoculation was made. So I am confident that no mistake, confounding the morbid changes of septicæmia or of other diseases with those of swine-plague, has occurred.

As this report is to be considered as a continuation, or rather completion, of my former reports, published in your Special Report No. 12, in your Annual Report for 1878, in your Special Report No. 22, and in your Annual Report for 1879, it will be best, in order to avoid as much as possible unnecessary repetitions, to adopt the same headings, and to arrange the material on hand in the same order as in the previous reports.

1. DEFINITION OF SWINE-PLAGUE.

But little needs to be added under this head to what has been previously said. The following will suffice:

Swine-plague, though a disease peculiar to swine, can, under favorable circumstances, be communicated to other mammals, and under very favorable circumstances probably also to human beings, but very likely not to barnyard fowls. It can and may attack one and the same animal twice, and even three times, but if it does, the second and third attacks are always mild ones and not apt to become fatal unless complicated with other diseases. As a rule, however, the first attack, provided the animal recovers, produces immunity from the effect of a subsequent infection, at any rate for some time and it may be for life. The same seems to destroy fully or partially the conditions necessary to the development of the swine-plague schizophytæ or schizomycetes. Even an interrupted attack, or, in other words, an infection that has been prevented from causing serious morbid changes, either by medical treatment or otherwise, as a rule, seems to produce immunity from the effect of a subsequent infection, the same as a fully developed attack. Further, wherever the morbid process of swine-plague has become sufficiently developed to produce morbid changes, serious enough to manifest their existence by a rapid emaciation, but particularly a permanent enlargement of the mesenteric lymphatic glands, and of other lymphatic glands in general, the animal, if surviving, may regain its appetite and consume as much food as any healthy hog of the same age, but will never show adequate growth and thrift, and will be a source of loss to its owner as long as it lives. Growth and thrift, it seems, remain more or less unimpaired only in such cases in which the morbid process does not sufficiently develop to produce permanent morbid changes in the lymphatic system, or more particularly, permanent swelling and obstruction in the lymphatic glands.

Although the morbid process of swine plague can have its seat in almost any organ or part of the body, it must be considered as characteristic of the disease that the lungs invariably are more or less affected, and constitute in a large number of cases the principal seat of the morbid process. At any rate, in over two hundred post-mortem examinations I found, in every case, more or less of that peculiar hepatization characterized by its distinct limits, by its different appearance and color, according to its age, in different parts of the lungs, and sometimes even in adjoining lobules, and by the small red, or red-brown specks of extravasated blood, usually exceedingly numerous in those parts of the lungs not yet fully hepatized, or in the first stage of hepatization. So I have come to the conclusion that hepatization of at least some portion of the lung-tissue must be considered as a never absent morbid change, characteristic of the disease, and that no swine-plague is existing where the lungs are not morbidly affected, or where they are found to be in a normal condition. If other parts were not also frequently affected, and in some cases even more than the lungs, swine plague might be called a "bacteritic" pneumonia.

2. SYMPTOMS.

The disease, on a whole, was this year of a much milder type and less complicated than in 1878 and in the early part of 1879, and the symptoms, therefore, were less varied, but otherwise exactly the same as those given in my first report, and so nothing needs to be added. Moreover, the symptoms of swine plague are sufficiently known to most farmers to enable them to recognize the disease when it makes its appearance. Great dumpishness and total indifference to surroundings, observed this year in some cases, proved to be the effect of serious morbid changes in the liver, caused, however, more by the presence of numerous entozoa in the hepatic ducts than by the morbid process of swine-plague.

3. PROGNOSIS.

In my last report I said, in regard to prognosis, that the same, though always unfavorable, is, as a rule, not quite so hopeless in the winter and spring as in the summer and early autumn, probably because in the former seasons the seat of the morbid process is limited more frequently to the respiratory organs and to the pulmonary tissue, and is not found so often in the intestines. Still this difference, partially due, no doubt, to some other causes and conditions to be explained below, is not a very great one, especially if it is taken into consideration that swine plague is always more fatal to very young pigs than to older animals or full-grown hogs, and that more pigs are born in the spring than at any other season of the year.

The above observation concerning the prognosis, although undoubtedly correct, needs a slight modification. The death rate in a herd of swine affected with swine-plague is also increased or decreased respectively by the comparative malignancy or leniency of the epizooty, which, it seems, depends largely, on the one hand, upon the rapidity with which the swine-plague schizophytæ change, develop, and propagate, and, on the other hand, upon the size of the herd, the condition of the premises on which they are kept, the number of diseased animals in the herd, and the mode and manner in which the animals are attended to. Everything else being equal, the mortality, as a rule, will be the greater the more rapidly the disease is spreading from one animal to another, and the more abundant the infectious principle, the swine-plague schizophytæ. This is easily explained. The larger the herd and the greater the number of animals diseased at the same time, the greater is also the quantity of the excretions containing the swine-plague schizomycetes or schizophytæ, consequently the more abundant the means of infection, and the more rapid the spreading of the disease within the herd. Again, a rapid spreading causes many animals to become affected at the same time and thus increases not only the sum total of the number of schizophytæ discharged with the excretions of the diseased animals, but also the quantity of the infectious principle taken up by each individual pig. As a consequence the single attacks become the more malignant and the more fatal the more rapidly the disease is spreading; and *vice versa*, the more malignant the single cases the more rapid will be the dissemination of the infectious principle and the spreading of the disease. That such is the case becomes yet more apparent if it is taken into consideration that ulcerous tumors in the cæcum and colon are, according to experience, a more frequent occurrence—are found in about 90 per cent. of all cases if the epizooty is malignant and occurs less frequently—are found only in about 40 or 25 per cent. of all cases if swine-plague presents itself in a comparatively mild form; and that wherever ulcerous tumors are existing much more infectious material (schizophytæ) is discharged with the excrements than in cases in which ulcerous tumors are wanting, or in which the intestinal canal is not seriously affected.

MORBID CHANGES.

On the whole the morbid changes found at the *post-mortem* examinations in 1880 do not essentially differ from those observed in 1878 and 1879. Qualitatively they are exactly the same. In the fall of 1878, and in the winter of 1878–'79, swine plague presented itself in a very malignant form almost everywhere where it made its appearance, and besides the never-absent morbid changes in the lungs, consisting in a peculiar hepatization of a larger or smaller portion of the pulmonary tissue, and in a deposit of fluid exudation and numerous small extravasations of blood in the non-hepatized parts of the lungs, other important and characteristic morbid changes, especially in the cæcum and colon, and presenting themselves as ulcerous tumors, projecting like knobs or buttons over the surface of the mucous membrane, were found in about 90 per cent. of all cases examined. In the winter of 1879-'80 the disease, on a whole, was much milder, and those ulcerous tumors presented themselves in about 50 per cent. of the cases examined, while in the spring, summer, and fall of 1880 the disease prevailed in a still more lenient form, and the morbid changes in the cæcum and colon, the ulcerous tumors, were not found in more than 25 or 30 per cent. of the cases examined. The morbid changes in the lungs, however, proved to be exactly the same in 1880 as in 1878, at any rate presented in both years the same pathological features.

Entozoa, such as *Strongylus paradoxus* in the bronchial tubes, *Ascaris lumbricoides* in the stomach and duodenum, and *Trichocephalus crenatus* in the cæcum, but especially the two former, have been found in quite a number of cases, but it will hardly be necessary to say once more that these worms do not constitute the cause of swine plague, and that their presence is merely an accidental complication, well calculated, though, to increase the malignancy of the morbid process, because their presence necessarily weakens the constitution of the animal, and thus facilitates the operations of the schizophytæ. On the other hand, worms always thrive better in a diseased or declining organism thán in a healthy animal. The two last-named entozoa have been found in several cases, in which their presence was not attended with any conspicuous morbid changes in those parts—stomach and intestines—in which the worms were found. The same, of course, cannot be said of *Strongylus paradoxus* in the bronchial tubes, because in every case of swine plague the lungs are more or less diseased, and it is exceedingly difficult to determine how much or how little the presence of those worms may have contributed in bringing about those changes. In parts of the lungs but little affected by the morbid process of swine plague, but infected with lung-worms (*Strongylus paradoxus*) the mucous membrane of the bronchial tubes presented a little swelling or what may be called a catarrhal condition.

In my last report I advanced reasons for the less frequent occurrence of the ulcerous tumors in the large intestines in the summer and fall of 1879 and in the winter of 1879-'80 than in the fall of 1878. The same undoubtedly are well founded, and have contributed in bringing about the above result, but I find that the causes assigned are not the only ones. The occurrence of those ulcerous tumors is the more frequent the more virulent the morbid process, and the comparative malignancy or leniency of the latter depends largely upon the rapidity or slowness respectively with which the schizophytæ propagate and undergo transformation, as will be more fully explained under another heading.

Professor Dr. Roloff, director of the Royal Veterinary School at Berlin, states in a private letter of recent date that ulcerous tumors in the cæcum and colon are not found at the *post-mortem* examinations of pigs affected with swine plague (*Schweine-Seuche*) in Germany, and hints at the possibility of those ulcerous tumors being foreign to the morbid process of swine plague, and previously existing complications, or morbid changes of longer standing than those produced by the morbid process of swine plague. That such is not the case—that, on the contrary, those ulcerous tumors, though not present in every case, constitute one of the most characteristic morbid changes of swine plague, and are the product of the morbid process of that disease, is proved beyond a doubt, 1, by the frequency of their occurrence in such experimental pigs as were perfectly free from any scrofulous or tuberculous affection, and in every respect in good health when inoculated with swine-plague material. If those ulcerous tumors were previously existing complications they would not have been met with in any of my experimental pigs, because I have been very careful and very particular, especially in 1878–'79, when ulcerous tumors were more frequently met with than in 1880, in selecting none but perfectly healthy animals for experimental purposes, unless experimental pigs Nos. 3, 4, 5, 6, and 7, bought this year of Mr. Lawrence, are exceptions. They were, as is stated below, coughing some when I received them, because they had lung-worms, but were otherwise healthy and perfectly free from any scrofulous or tuberculous affection. But neither No. 4 nor No. 5, the only ones of that lot which died of swine-plague, had any ulcerous tumors in the cæcum or colon (*cf.* account of *post-mortem* examination below). 2, by the fact that the morbid process of swine plague, wherever it causes sloughing or ulceration on the external surface of the body, for instance, in the eyelids, in the noses of pigs that have been ringed, in the lips and faces of small suckling pigs that have been fighting for a teat, in the scrotum of pigs recently castrated, and in any other sore or wound that may happen to exist, produces almost precisely the same morbid changes—a proliferous growth of morbid cells and granular detritus—as in the ulcerous tumors in the cæcum and colon.

In other respects, no essential differences have been observed. The disease of 1880 is exactly the same swine-plague that prevailed in 1878–'79; it is only less malignant, and spreads with less rapidity. A rapid spreading and a frequent occurrence of ulcerous tumors go together, because the schizophytæ, which are voided with the excrements, are, for reasons explained before, better calculated to spread the disease from animal to animal and from herd to herd, than those discharged by, or emanating from, the body of a diseased hog in any other way or manner; and the more developed the morbid process in the intestinal canal, the greater the number of swine-plague schizophytæ discharged with the excrements. As said before, the disease in all other respects proved to be exactly the same as in 1878–'79, and presented essentially the same features in different localities. A comparison of the morbid changes found at the *post-mortem* examinations, made at different places, will show that such is the case. In order to avoid too much repetition, I shall only give an account of about a dozen *post-mortem* examinations which, covering the whole time from April till date, in the central, eastern, southern, and western parts of the State of Illinois, will probably suffice. It may be remarked here that in the following accounts all such parts and organs as did not present any visible morbid changes are, as a rule, not mentioned. So, for instance, where no external morbid changes, such as redness of the skin, petechia, &c., were found, nothing is said about external appearances. Wherever entozoa (worms) were present it will be mentioned.

POST-MORTEM EXAMINATIONS.

1. *Mr. Dillon's pig No.* 1.—Autopsy in forenoon of April 6. The pig, about five or six weeks old, had died in the morning. Lymphatic glands diseased and swelled; lungs but slightly affected; morbid changes (hepatization) restricted to lower parts of anterior lobes; numerous ulcerous tumors in cæcum and colon.

2. *Mr. Dillon's pig No.* 2 (*belonging to the same litter as No.* 1).—It had died during the night. Autopsy in the forenoon of April 6. Lymphatic glands enlarged; about one-half of the whole lung-tissue degenerated; red, brown, and gray hepatization; considerable serum in the pericardium, and auricles of heart congested, that is, the smaller blood-

vessels and capillaries turgid with dark-colored blood. No ulcerous tumors.

3. *Dillon's pig No.* 3.—Of the same age as Nos. 1 and 2, in a dying condition, and killed by bleeding in forenoon of April 9. Autopsy two hours later. Morbid changes: eyelids swelled and eyes almost closed; more than half of the substance of the lungs hepatized; all lymphatic glands, but particularly those situated in the large cavities of the body, enlarged; some serum in the pericardium, and a small portion of the liver congested; no other morbid changes.

4. *Experimental pig No.* 4—*a black boar pig, about six months old.*—It was inoculated with material lung exudation from Dillon's pig No. 2, on April 7, showed first symptoms of disease on April 10, and died on the night of April 23–24. Autopsy at 8 a. m. of April 24. Morbid changes: eyes closed and eyelids ulcerating; nose—the pig had been ringed before I bought it—swelled, sore, and ulcerating; skin on scrotum and between the legs reddish-purple. Internally, all lymphatic glands enlarged; the lungs very extensively degenerated; the left lobe about half hepatized, and the non-hepatized parts, that is those in which the normal structure was yet preserved, containing innumerable small extravasations of blood, and a large quantity of recent and yet fluid exudation; in the middle of the external surface of the lobe a portion of the pleura, of the size of a silver dollar, adhering to the costal pleura, and the pulmonary tissue beneath very hard and solid. The right lobe of the lungs almost entirely hepatized, very solid, of an almost uniform brown color, and adhering nearly with its whole external surface (lung-pleura) to the costal pleura or to the wall of the chest. Both lobes appeared very much enlarged and completely occupied the whole space in the chest, pressing even the diaphragm backward. The bronchial tubes contained some lung-worms (*Strongylus paradoxus*). About three or four drams of serum in the pericardium; the heart very large, and its blood vessels and capillaries, not only in the walls of the auricles but also in the walls of the ventricles, gorged with dark-colored blood. The blood in the veins and in some arteries coagulated of a brownish or carbonized red color, but was apparently very much diminished in quantity. In the abdominal cavity, the spleen slightly enlarged; all mesenteric glands very large, and the blood vessels of the mesenterium turgid with dark-colored blood. No developed ulcerous tumors in large intestines, but the mucous membrane of the cæcum swelled, and of a granular appearance. (As to the morbid changes in the lungs *cf.* microphotograph, Plate 1.)

5. *Experimental pig No.* 5.—This animal was about six months old, and was inoculated with lung-exudation of Dillon's pig No. 1 on April 7, was taken sick on April 11, and died late in the evening of April 30. The autopsy was made early in the morning of May 1. Morbid changes: Externally, the skin on snout, between fore legs under the abdomen, and between hind legs, purplish red. Internally, the blood vessels (veins) almost destitute of blood, and the little blood that was found of a very dark (carbonized) color, till it had been exposed to the air for some time. The larger veins (vena cava, posterior and anterior) contained firm and solid white-yellowish strands of coagulated fibrine. All lymphatic glands very much enlarged. The lungs, which entirely filled the space of the thoracic cavity, very extensively degenerated. In the left lobe hepatization most developed in the anterior and lower portions, and extending to about half of the whole pulmonary tissue. In the center of the hepatized parts some whitish or straw-colored (about the color of old cheese) consolidation presenting the appearance of a dense

and hard fibrous tissue. The non-hepatized portions of the left lobe œdemic, and containing a large quantity of fluid exudation. The hepatized portions everywhere distinctly limited. Adhesion between lung-pleura and costal pleura at several places. In the right lobe of the lungs still more extensive hepatization, extending to about three-fourths of the whole tissue. The lung-pleura also at several places adhering to the costal pleura, and the union firm enough to require a knife to effect a separation. In the hepatized portions several straw-colored or dirty white-yellowish spots caused by incipient detritus. The non-hepatized portions of the lung-tissue œdemic, and, like those of the left lobe, full of fluid exudation, and of minute red spots consisting of extravasated blood. A considerable quantity of straw-colored serum in the thoracic cavity, and an ounce or more in the pericardium. As to the morbid changes presented by the heart, all blood vessels in the walls of the auricles, and many of those in the walls of the ventricles, turgid with dark-colored blood. (Plate I is a photograph, considerably reduced, of the lungs of experimental pig No. 5.) In the abdominal cavity, the liver dark colored, and twice or more its normal size, but presenting no other morbid changes, except congestion. All mesenteric glands very much enlarged, and the blood vessels of the mesenterium turgid, with dark-colored blood, giving them the appearance of having been artificially injected with some dark-colored injecting fluid. No other morbid changes, except some swelling of the ileum, or thickening of the walls of that intestine, caused probably by the presence of some *ascarides*, of which one large specimen (a female) was found in the stomach. All intestines empty, that is, containing no food whatever, but a little yellowish-colored mucus.

6. *Mr. Phillipi's pig, an animal about five weeks old, and sick for some time.*—It was killed by bleeding on May 24. Autopsy immediately after death. Morbid changes: Externally, a big slough on the right side of the head, where, it seems, it had been bitten by another pig. Internally, all lymphatic glands enlarged; nearly everywhere adhesion between the pulmonary and costal pleuras; fully one-half of the whole lung substance, but mostly in the posterior portions of the lobes, and more in the right lobe than in the left, degenerated by the usual and characteristic hepatization, and the non-hepatized parts presenting innumerable small red specks of extravasated blood, and containing a considerable quantity of recent fluid exudation. The blood everywhere carbonized or dark-colored till it had been for some time in contact with the air, when its color changed to a brighter red. Heart and pericardium firmly united with each other, and not separable. On the pleura of the left half of the chest, not far from the posterior aorta, a whitish nodule of the size of a pea, and of a soft, somewhat pulpy consistency (*cf.* microphotograph No. 2). No morbid changes in the abdominal cavity, except enlargement of the mesenteric glands.

7. *Mr. William Carson's pig No.* 7.—Mr. Carson lives five miles southeast of Tolono, and has lost about 25 head of swine out of a herd of 50. The pig examined died June 16, and had been dead but one or two hours when the autopsy was made. Morbid changes: Externally, the skin of the lower surface of the body covered with small scurfs (eruptions) of the size of half a pea. Internally, a portion of the lung-pleura of the left lobe of the lungs, at one place about the size of a quarter of a dollar, adhering to the costal pleura; about one-fourth of the pulmonary tissue of the left lobe, mostly in its posterior and inferior parts, hepatized and diseased, and about three-fourths of the tissue yet healthy. The lung-pleura of the right lobe adhering with more than one-fourth of

its whole external surface to the costal pleura, and at one place also to the diaphragm. The lung-tissue of the right lobe almost entirely, or more than three-fourths of it, diseased and hepatized; the hepatization in both lobes variegated (marbled) in appearance, and evidently of different age, and in different stages of development, in different parts of the lung-tissue, and even in adjoining lobules, showing plainly that the morbid process had been subject to remissions and exacerbations. Nearly an ounce of serum in the pericardium, the heart large and flabby, and the blood vessels in the walls of the auricles full of blood, presenting the usual dark color. All lymphatic glands swelled. In the abdominal cavity numerous ulcerous tumors in the cæcum and in the colon; those in the latter larger, and those in the former a good deal smaller, but more numerous (*cf.* photograph of ulcerous tumors in colon, Plate II).

8. *Mr. Postlewhaite's pig No.* 1.—Mr. P. lives five or six miles south of Philo, on the Embra River, in Champaign county, Illinois. The pig examined was a suckling pig, about three or four weeks old, and was killed by bleeding on June 27. Autopsy immediately after death. Morbid changes: Externally, a large slough or sore in the left corner of the mouth (see microphotograph No. 3), and another one on the chin. Internally, swelled lymphatic glands and hepatization of a small portion of the lung-tissue of the size of half a cubic inch or a trifle more, where the left anterior lobe joins the left lobe (see microphotograph No. 4). No other morbid changes.

9. *Experimental pig No.* 11.—This animal was about four months old at its death, and was inoculated with lung-exudation of Mr. Carson's pig at 6 o'clock, p. m., June 16. Was taken sick, or showed the first symptoms of disease on June 21, and was killed by bleeding, when already in a dying condition, on July 20. Autopsy immediately after death. Morbid changes: The carcass emaciated to the utmost, the blood thin and watery, and the adipose tissue almost entirely wasted away, notwithstanding that the pig was in an excellent condition and a very fine animal when inoculated on June 16. Internally, all muscles pale and atrophic; lymphatic glands enlarged; lungs partially hepatized; hepatization extending to about one-fourth of the tissue of the left lobe, and to two-fifths to one-half of the tissue of the right lobe; hepatized or degenerated parts presenting everywhere a somewhat whitish or dirty-whitish appearance; no inflammation or fresh exudation in the lungs, the diseased parts evidently undergoing a retrogressive process. On a cut the hepatized parts exuded a whitish, somewhat grumous or sticky and semi-fluid substance, altogether dissimilar to fresh exudation as well in color as in consistency. In the finer bronchial tubes some rather large lung-worms (*Strongyli paradoxi*). (See microphotograph No. 5.) Most of the hepatization in the posterior parts of the lobes. All other parts, such as liver, spleen, stomach, intestines, kidneys, pancreas, spinal cord, &c., without any morbid changes; only in the cæcum a little swelling of the mucous membrane, and in some places congestion. All intestines nearly empty, except the stomach, which contained a little food mixed with coal dust and particles of hay from the bedding. No intestinal worms.

10. *Experimental pig No.* 10.—This animal belonged to the same litter as No. 11, and was a very fine pig when I received it. It was inoculated with same material as that of Mr. Carson's pig on June 16; was taken sick, or showed the first symptoms of disease on June 21, and died in the forenoon of July 24. Autopsy immediately after noon the same day. Morbid changes: Externally, the carcass, to the utmost, emaciated; the skin of nose, mouth, and lower surface of the body bluish purple; just

beneath the sternum a blackish slough, presenting a mortified surface, and extending to the bone, caused probably by decubitus. Internally, all lymphatic glands enlarged; the external surface of the lungs (lung-pleura) almost everywhere, but especially with its lower or inferior portions, adhering to the costal pleura or the wall of the chest. On the external surface of the pleura of the left lobe a layer of cheesy detritus (old plastic exudation) of about one-fourth to one-half of an inch in thickness, one and a half inches in width, and six or seven inches in length, extending and coating the pleura like a shred from the anterior part of the lower border to the posterior upper angle of the left lobe, and forming the means of adhesion between the lung-pleura and the costal pleura, but sticking to the former after a separation had been effected. About one-third of the substance of the left lobe completely hepatized, but most of the hepatized lobules in the lower and posterior parts of the lobe. The right lobe of the lungs affected in a similar manner, and presenting a similar appearance as the left; but the layer of detritus (old plastic exudation) of less thickness and extension. The pericardium very much congested, and showing incipient gangrene where attached to the sternum. The bronchial tubes contain some, but not many, lung-worms (*Strongylus paradoxus*). In the abdominal cavity, the liver three to four times its normal size, and full of cavities, containing worms and lime-deposits in the bile-ducts. In the stomach numerous ascarides, and in the small intestines, but especially in the duodenum, numerous calcareous deposits, the same as in the bile-ducts. No ulcerous tumors in the cæcum and colon. All intestines contained some fluid, but no food whatever.

11. *Experimental pig No.* 12.—Of the same litter as Nos. 10 and 11, and a very fine animal, and in first-class condition when received. It was also inoculated on June 16 with lung-exudation of Mr. Carson's pig, showed first symptoms of disease on June 21, and died July 27, three days later than No. 10, and seven days later than No. 11. Autopsy immediately after death. Morbid changes: Partial adhesion between pulmonary and costal pleuras; hepatization (see microphotograph No. 6) in both lobes of the lungs, extending in the left lobe to about one-half and in the right lobe to about one-third of the pulmonary tissue. Heart and pericardium firmly united with each other by a layer of old plastic exudation of a dirty white-yellowish color, and pericardium very much inflamed. In the abdominal cavity the liver about three times its normal size, presenting on its surface a knotty and in its interior a honey-combed appearance, caused by numerous cavities or enlargements of the bile-ducts, occupied by entozoa. The choledochus inflamed and distended to such an extent as to admit the introduction of a finger; the contents of the gall-bladder a watery fluid, mixed with coagulations of a flaky appearance. Entozoa, or worms: some, but not very many, lung-worms (*Strongylus paradoxus*) in the bronchial tubes, and numerous *ascarides* in the bile-ducts, in the stomach and in the duodenum.

12. *Mr. Bailey's pig No.* 1.—A four-months old boar-pig of the Berkshire breed, which was killed by bleeding on August 25. Autopsy immediately. Morbid changes: Externally, three ulcers or sloughs on the nose and in the face (see microphotograph No. 7). Internally, over two-thirds of the lung-tissue hepatized; some serum in the chest and in the pericardium; and all lymphatic, and particularly the mesenteric, glands morbidly enlarged. No other morbid changes.

13. *Mr. Bailey's pig No.* 2.—This animal was two months old, and was killed and examined the same day as No. 1. Morbid changes: Externally, a hard swelling in the lower jaw, affecting the bone, and ulcera-

tion (sloughing) in the mouth. Internally, the blood dark colored (Mr. B. killed the pig by striking it on the forehead with a club), and about one-fourth of the lung-tissue hepatized. No other morbid changes of any importance, except enlargement of some lymphatic glands.

14.. *Mr Isaac Martin's pig.*—This animal, about four months old and in the last stage of a malignant form of swine plague, was killed by bleeding on September 18. Autopsy immediately after death. Morbid changes: Externally, considerable swelling of the sheath. Internally, the blood dark colored; all lymphatic glands very much enlarged. In the lungs about two-fifths of the tissue of the left lobe and about three-fifths of the tissue of the right lobe diseased, and in some parts hepatized to such an extent as to be perfectly solid. The other non-hepatized portions, that is, those in which the structure of the lung-tissue was yet normal, or nearly normal, full of fresh and yet fluid exudation, and presenting innumerable small red specks of extravasated blood, each speck or spot of the size of a pin's head or smaller, and situated not only near the surface, but everywhere, the same as in other cases, in the interior of the lung-substance. The pleura coated with exudation, and rough at several places; some serum in the pericardium, but the heart and its auricles without any conspicuous morbid changes. In the abdominal cavity numerous and exceedingly large, thick, and well-developed ulcerous tumors, presenting a black surface, in the cæcum and in the colon—those in the cæcum—(see microphotograph No. 9) being the largest—several (about a dozen) small entozoa (*Trichocephalus crenatus*) in the cæcum; and mesenteric glands very much enlarged. No other morbid changes of any importance.

15. *Mr. Munday's pig.*—This animal, about five or six months old, was killed by bleeding on October 13. Mr. M. lives in Effingham county, between Watson and Effingham. Autopsy immediately after death. Morbid changes: About half of the lung-tissue hepatized; in the non-hepatized parts considerable fluid exudation and numerous extravsations of blood, presenting themselves to the naked eye as minute red spots; hepatization and other morbid changes more developed in the right than in the left lobe of the lungs; a small quantity of serum in the pericardium, and a comparatively large quantity (over a pint) in the abdominal cavity; all lymphatic glands, but particularly those of the mesenterium, considerably enlarged; a number of worms (*Trichocephalus crenatus*) in the cæcum (see microphotograph No. 11); the mucous membrane of the cæcum and in some parts of the colon slightly swelled, and the contents (feces) of both intestines, but especially of the colon, hard and lumpy. No other morbid changes.

16. *Mr Beaty's pig.*—A small animal, about four or five months old, was killed by bleeding on November 6. Mr. B. lives in Henderson county, about four miles from Oquawka. Autopsy immediately after death. Morbid changes: Externally, swelling and ulceration in the nose and in the scrotum (the pig had been ringed and castrated a few weeks before it was taken sick, but at a time when swine plague was prevailing in Mr. Olson's herd, about a mile and a half from Mr. Beaty's place). Internally, the blood of normal appearance; all lymphatic glands, but especially the inguinal glands, very much enlarged; the lungs completely filling the space in the thoracic cavity in the left lobe, about half of the lung substance hepatized, and the non-hepatized tissue containing a considerable quantity of fresh and fluid exudation and numerous small red spots of extravasated blood (see photograph, Plate III); in the right lobe similar morbid changes, only a little less extensive; in the pericardium over an ounce of straw-colored serum. In the abdominal cavity some

serum; the mesenteric glands enlarged; a number of dead *ascarides* (the pig had been treated with carbolic acid for a few days) and small lumps of slate-colored feces in the posterior part of the colon; and a yellowish fluid largely composed of bile, but no food, in the stomach and small intestines. No other morbid changes of any importance.

The results of these sixteen *post mortem* examinations are probably sufficient to show that the morbid changes observed in 1880 are essentially the same as those found in 1878–'79, only, on an average, a little less complicated, because the morbid process, upon the whole, was less acute and less malignant. The cases given have been chosen because they cover the whole time from April to November, and all of them have furnished material for special examination, and most of them also for inoculation. Others might be added, but as no morbid changes not met with before, or not found at one or another of those *post mortem* examinations the results of which have been given, have come to light, to do so would simply be repeating the same thing over and over again.

EXPERIMENTS.

The experiments made since the first days of April at my experimental station, located till September on the grounds of the Illinois Industrial University, at Urbana, Champaign county, Illinois, and afterwards on private grounds near my boarding place in Urbana, have been made with several objects in view.

1. My former experiments and observations proved that swine plague can be, and is, communicated through the digestive canal, and through sores, wounds, and scratches, even of the smallest character, in the skin and mucous membranes, but they did not show that the infectious principle was able to enter the organism of a healthy animal through the unwounded and perfectly uninjured skin and respiratory mucous membranes, and produce disease by simply being inhaled where healthy and diseased swine were compelled to breathe the same atmosphere. Notwithstanding an infection or a communication of swine plague by mere inhalation may be possible, I made it an object to ascertain whether the disease can be communicated not only by an absorption of the infectious principle through the digestive canal and through external sores, wounds, and lesions, but also by an absorption of the same through the uninjured skin and whole and healthy respiratory organs, because if such should prove to be the case, even a strict separation of healthy swine from diseased ones would not be of much avail as a measure of prevention, and, contrary to my former observations, could not be relied upon. On a farm a separation can seldom be carried so far as to prevent the inhalation of an infectious principle that is carried through the air, and evidently attracted and absorbed by wounds and scratches, even if the source of the infection, that is, the diseased herd of swine from which the infectious principle emanates, is over a mile off.

2. In my former experiments, but especially those conducted during the fall of 1879 and the winter of 1879–'80, I had very good success in preventing a development of the morbid process of swine plague in animals which had been exposed to infection, and very likely had become infected, and thus, in arresting the progress of the disease within infected herds by treating those animals not yet plainly diseased with antiseptic medicines, such as carbolic acid and hyposulphite of soda, &c. (*cf.* my former reports). I therefore concluded to subject the same medicines and a few others to a thorough test as to their practical value as preventives.

3. In the fall of 1878 and in the winter of 1878–'79 comparatively few

recoveries from swine plague were observed—the disease was very fatal—but in the spring, summer, and fall of 1879 and in the winter of 1879–'80 recoveries were more numerous, but it was very seldom noticed that an animal, once recovered, contracted the disease a second time, and only once that one and the same animal contracted the disease three times, but each time before it fully recovered from the previous attack. In every case, however, the second attack proved to be a comparatively mild one and did not become fatal, at least not in those cases which came under my observation. It was therefore another object to ascertain more positively whether an animal once recovered from an attack of the plague will contract it again if inoculated or exposed to infection, or will, as a rule, resist the influence of the infectious principle and possess immunity. Further, if such should prove to be the case, I considered it as important to determine by experiments whether a very mild attack of swine plague, such a one as leaves hardly any morbid changes behind, will produce just as much immunity from infection as a severe one, or whether it is only the permanent morbid changes left behind by the latter that protect the animal in the future.

4. My former experiments seemed to indicate that an inoculation with cultivated material (cultivated swine-plague schizophytæ) produces a milder form of disease than a natural infection or an inoculation with unadulterated material taken directly from the body of a diseased or dead animal. Hence, if it should be found that a mild attack, one that does not leave any serious morbid changes behind, protects an animal against subsequent infection, and if an inoculation with cultivated schizophytæ produces invariably, or, as a rule, a comparatively mild form of disease, such inoculations might be made use of as a means of prevention, or rather of reducing the losses caused by swine plague. It was therefore deemed of importance to contribute as much as possible to the solution of that question.

5. As it is claimed by some people, misled probably by the two misnomers "hog cholera" and "chicken cholera," that the disease known by the latter name is identical to swine plague, I have endeavored to dispose of that question.

I will, as heretofore, first relate my experiments and then state the conclusions arrived at. In order to avoid too much repetition I shall omit a daily record of all pigs not showing any disease. Hence, all those experimental pigs not mentioned every day either did not show any morbid symptoms and appeared healthy, or did not present any changes since the date at which they were last mentioned.

My experimental pig-pen, a frame building 16 feet long and 20 feet wide, and divided into eight pig-pens, a place for corn and a chicken-pen, or ten apartments each 4 feet wide and 8 feet long, was finished on April 6.

On the morning of April 7 I received five pigs from Mr. Lawrence, head farmer of the Illinois Industrial University, and put them respectively in pens Nos. 3, 4, 5, 6, and 7. The pigs, for convenience sake, received the same numbers as the pens which they occupied. Pens Nos. 1, 2, and 8 remained empty. Pigs Nos. 4 and 5 were inoculated at 1.30 p. m., with lung exudation of Mr. Dillon's pigs Nos. 1 and 2 (*cf.* account of *post-mortem* examination of those pigs).

April 8.—Pig No. 4 eats and drinks well; the others do not seem to feel at home, being confined one by one in a small pen. They have therefore not consumed all the food given them. They also cough some, like pigs infected with lung-worms (*Strongylus paradoxus*), but the cough is decidedly different from that usually heard in swine plague.

All the animals came from the herd of the University farm, in which no swine plague had existed for over a year, and which remained exempt up to this date. Further, no swine plague had existed in the neighborhood for a year, so the cough could not have been the result of that disease. In the evening pigs Nos. 4 and 5 appeared to be feverish and were shivering, but it was not plain whether on account of the chilly night air, or already in consequence of the inoculation.

April 9.—It having been asserted that so-called chicken cholera and swine plague were identical diseases, I fed some chickens which I had procured, with half of the lungs, the heart, and the liver of Dillon's pig No. 3 (see account of *post-mortem* examination of that pig). Commenced cultivating swine-plague schizophytæ, and charged 2 ounces of fresh milk, 2 ounces of water, and the albumen of an egg, each with two drops of the pulmonary exudation of Dillon's pig No. 3. In the evening experimental pig No. 5 is shivering and appears to be cold.

April 10.—Pig No. 4 appears to be indisposed, and shivers. All the pigs, Nos. 4 and 5 included, eat and drink well.

April 11.—No. 5 seems to be indisposed, is loath to get up, and shivers. One of the chickens does not go to roost, and does not seem to be well; on examination it is found that it is affected with what is known as "scaly legs." Took scabs and examined them under the microscope for mites, but did not find any.

April 12.—Pig No. 4 does not eat well, and pig No. 5 is shivering, apparently cold. All other pigs are doing well. Fed to pig No. 7, a large sow pig six or seven months old, the infected albumen, and put the albumen of another egg into the vessel, a quinine bottle, which still contained a drop or two of the infected albumen.

April 13.—Pigs Nos. 4 and 5 show insufficient appetite; the former shivers.

Received six more pigs of the Berkshire breed, each about three and a half or four months old, from Mr. Dallenbach, and placed and numbered them as follows: Two in pen No. 1, to be known as No. 1 A and No. 1 B; two in No. 2, and designated as No. 2 A and No. 2 B; and two in pen No. 8, to be called No. 8 A and No. 8 B.

April 14.—Pig No. 5 decidedly sick and feverish; seems to be weak in the hind quarters. No visible change in pig No. 4. Inoculated pig No. 2 A with swine-plague schizophytæ cultivated in milk, and pig No. 2 B with schizophytæ cultivated in water. All inoculations, unless otherwise stated, have been made on the outside of an ear and with a small spoon-shaped, but sharp inoculation needle, made originally for the purpose of inoculating sheep with the virus of sheep-pox.

April 15.—Pig No. 5 very sick, and does not like to rise when called upon; pig No. 4, though still lively, is also evidently ailing. Pig No. 7 received in its trough the albumen infected on April 12, and the albumen of another fresh egg was put in the bottle, which, as before, still contained a few infected drops.

April 16.—Pig No. 5 is very sick, but takes a little food in the evening. Is nearly always lying in a corner of its pen during the day, and does not like to get up when asked to do so. When on its legs walks to the trough to get a swallow of water, and then returns to its corner and lies down again. It shows considerable weakness in its hind quarters, and shivers when lying down. Its cough (as has been stated, all five pigs received from Mr. Lawrence cough some, and very likely have lung-worms) has changed, sounds hollow, is weak, and characteristic of swine plague. Pig No. 4 is yet active, and eats and drinks some, but near as much as any of the other pigs. Its cough, too, is getting hollow and weak, and sounds like swine plague. Both pigs, Nos. 4 and 5, have sore noses. (It may be stated here that all five pigs received from Mr. Lawrence had rings in their noses when I received them.)

April 17.—Pig No. 4 has suddenly become worse, and is even worse than No. 5. It hardly touches its food, is thin, gaunt, and emaciated, and coughs that peculiar weak cough characteristic of an advanced stage of swine plague. Pig No. 5, though lying most of the time shivering in a corner, has eaten a little, and consumed about one ear of corn during the day. Both pigs exhibit a thumping motion of the flanks. All other pigs apparently healthy. Pigs Nos. 2 A and 2 B have a ravenous appetite, and though the smallest of all, eat fully as much as any. Nos. 1 A and 1 B seem to be healthy, but one of them has commenced to cough; has not coughed before, neither have any of the six pigs received from Dallenbach.

Dillon's pig No. 3 (see account of *post-mortem* examination) was killed on the 9th of April at 10.30 a. m. at Mr. Dillon's place, a few miles north of Champaign, and about 3½ miles from my experimental pig-pen. The carcass was then thrown into the buggy, and taken to the experimental station for dissection. Arriving there a little before noon, having to dispose of horse and buggy, and finding the dissecting-room of the veterinary building locked—the latter and my experimental pig-pen were only a few rods apart—I put the dead pig in the trough of pen No. 1, then not occupied, till I would be able to make the autopsy. When the carcass was removed to the dissecting-room, immediately after noon, I found that the trough had become soiled with a few drops of blood, which were left there on purpose, because I expected to get more pigs, and wished to see whether so small an amount of blood, after exposing it to the influence of the atmosphere for a few (four) days, would be able to cause an infection, if left where it was to become dissolved by and mixed with the water for drinking. On April 12, as already stated, pen No. 1 became occupied by pigs No. 1 A and No. 1 B.

April 18.—Pig No. 1 B is coughing and does not eat well; pig No. 4 snuffles, and its nose is much swollen, very sore, and ulcerating; pig No. 5 eats and drinks a little; pigs Nos. 2 A and 2 B do not show any symptoms. All others apparently healthy.

April 19.—Both pigs, Nos. 4 and 5, very low, but No. 4 especially so; the latter does not eat anything; breathes very hard; its nose is much swelled, and every respiration causes a snuffling sound. No. 5 eats a trifle, but lies most of the time shivering in a corner. Its nose is not sore, but looks very pale. Both pigs are emaciated. The other pigs exhibit no change, and all those not inoculated appear to be perfectly healthy. Pig No. 7 received again a dose of infected albumen, charged on April, 15, and once more the albumen of a fresh egg was put into the empty bottle, the same as on April 15.

April 20.—Pig No. 4 apparently in a dying condition; cannot live much longer; does not stir as formerly when urged to get up. No. 5 and all others the same as yesterday. (After about a week of dry weather a pouring rain; hail, thunder-storm, hurricane during the night, followed during the day by bright and clear weather.)

April 21.—Hardly any change; pig No. 4 has touched neither food nor water for four days; lies in a corner in a soporous condition, and does not stir when urged to get up; it breathes with great difficulty and with a pumping motion of the flanks; emaciation is very great; in the afternoon a very fetid diarrhea sets in (diarrhea, but not so fetid, has existed for the last twenty-four hours). No. 5 is neither worse nor better; drinks a great deal, and eats a small ear of corn in about 24 hours. Its nose is exceedingly pale, and the animal, when lying down, is almost constantly shivering, is if suffering from ague chills. No 7, shows swelling and ulceration of the nose, and is coughing a good deal; it received three times (April 12, 15, and 19) infected albumen. No. 1 B has not shown any change; is coughing, but eats and drinks. Nos. 2 A and 2 B eat vigorously. Nos. 8 A, 8 B, and Nos. 6 and 3 to all appearances are perfectly healthy.

April 22.—No. 4 still alive, but has not touched any food; neither has No. 5. Like No. 4, it lies in a corner in a soporous condition, and neither eats nor drinks. No. 4 seems to have great difficulty in exhaling—expelling the air from the lungs; the fetid diarrhea continues. The other pigs do not present any change.

April 23.—No. 4 still lies in its corner and cannot be induced to get up. No. 5 is weaker than yesterday. No. 1 B coughs a good deal, and No. 7 is indisposed, mopish, and does not eat well; both pigs are evidently affected. All others are well.

April 24.—Last night a tremendous rain and hurricane. Pig No. 4 found dead in its pen. It was dying in the evening of April 23, and probably died early in the night, before the rain and hurricane commenced. (For changes see account of *post-mortem* examination No 4.) Pig No. 5 lies in its corner, shivering as usual, and shows no change. Pigs Nos. 2 A and 2 B do not eat their food; seem to feel chilly, and are shivering. No change in the others. At 9 o'clock a. m., fed left lobe of the lungs and the liver of pig No. 4 to the chickens.

April 26.—Pigs Nos. 2 A and 2 B lack appetite, and do not eat their food. B, especially, droops its ears, seems to feel chilly, and coughs. No change in No. 5.

April 27.—Pigs Nos. 2 A and 2 B evidently affected; both droop their ears and are shivering. No. 2 B is quite sick and coughs considerably; it is mopish, and does not like to move. No. 5 staggered from its corner to its trough to drink, but did not eat anything.

April 28.—Pig No. 2 A presents no change; No. 2 B does not eat, and lies nearly all day in a corner shivering and shaking. No. 5 is apparently no worse; seems to be more inclined to move, but cannot be induced to take any food.

April 29.—No essential change in any of the pigs. No. 2 B seems to be a little worse, and is undoubtedly a sick pig. No. 5 is about the same as yesterday, perhaps weaker. Nos. 7 and 6 are coughing.

April 30.—No essential change. Pig No. 2 A eats about half a meal, and No. 2 B eats hardly anything at all. No. 5 is exceedingly weak, and collapsing; its temperature at noon was found to be 95° F. It died at 7 p. m. (For morbid changes see account of *post-mortem* examination No. 5.)

May 1.—Inoculated in the morning pigs Nos. 2 A and 3 with the fresh pulmonary exudation of pig No. 5. The operation was performed as soon as the exudation could be obtained after the chest had been opened. As every inoculation made with the exudation of the lungs proved to be successful, that is, productive of an attack of swine-plague, in my former experiments as well as in the present (*cf.* account of pigs Nos. 4 and 5), I concluded to try preventives. Pig No. 3 had never been inoculated, neither had it ever been sick, notwithstanding its pen (No. 3) is separated from pen No. 4 only by a board partition about 3 feet 10 inches high, in which pig No. 4 became sick and died.

Pig No. 2 A was inoculated on April 14 with swine-plague schizophytæ, cultivated in milk, and apparently had a very slight attack, but could hardly at any time be considered as a sick animal. It is a boar-pig and weighs about sixty pounds, while its companion, No. 2 B, is a sow-pig weighing about 40 pounds. Commencing at noon May 1, both pigs together received three times a day in their water for drinking about ten drops of carbolic acid, or rather of a solution of carbolic acid, composed of 95 per cent. of the pure crystallized acid and 5 per cent of water. For pig No. 3 I prepared an iodine solution, composed of 10 grains of iodine, 12 grains of iodide of potassium in half an ounce of water, and commencing at noon of May 1 gave it three times a day, in its water for drinking, a quantity sufficient to contain each time about 1 grain of iodide of potassium and a little less than a grain of iodine. As each time some water remained in the trough which had to be poured out again, only about half of that quantity was actually consumed. Pig No. 3 is a sow-pig, and weighed on May 1 about 60 pounds, or perhaps a little more. The carbolic acid and iodine treatment was commenced within five and a half hours after the inoculations had been made. In the morning the albumen of a fresh egg was put in a clean vial with a glass stopper, and charged with two drops of the pulmonary exudation of pig No. 5.

May 2.—No change for the worse in any of the pigs. Pigs Nos. 2 A and 2 B have better appetite. No. 2 A coughed a few times.

May 3.—Inoculated pigs Nos. 1 A and 1 B with the albumen charged with 2 drops of pulmonary exudation on May 1; transferred pig No. 2 B to pen No. 5, which had been left in exactly the same condition in which it was found when the carcass of pig No. 5 was removed. Pig No. 2 B is henceforth pig No. 9, and No. 2 A is simply No. 2. No essential change observable in any of the pigs.

May 4.—Pig No. 9 (old No. 2 B), which had a mild attack of swine plague after an inoculation with cultivated material, seems to be improving, and, though not entirely well, is not very sick. The carbolic acid treatment is continued. Pig No. 6 (a large sow and never inoculated, but ringed before I received her) has shown some symptoms of sickness for several days (since April 29), and is now evidently diseased. It is inclined to mope, eats very little, and its nose is ulcerating. No. 7 seems to be improving; all other pigs are doing well.

May 5.—Pig No. 6 is worse; has no appetite; don't eat anything. No other changes.

May 6.—No changes.

May 7.—Pig No. 6 is worse; lies almost always in its corner, and does not touch its food. Pig No. 9 shows again more indisposition, and does not eat well, but takes some food and water. No further changes.

May 8.—All pigs about the same as yesterday, except No. 7, which is mopish, less lively than during the last few days, and is eating very little. None of the inoculated pigs (Nos. 2, 3, and Nos. 1 A and 1 B) show any symptoms of disease.

May 9.—Pig No. 6 is decidedly worse, rises now and then from its corner to get a swallow of water, and then lies down again. It does not eat anything, and emaciation is apparent. Pig No. 7, which, so far, has received every three or four days a dosis of albumen, infected with cultivated schizophytæ, is evidently diseased; still, it eats and drinks some, but never more than about half an ordinary meal. Its nose, too, is very sore and ulcerating.

The chickens, which have been fed repeatedly with highly infectious parts of dead pigs, are all healthy, that is, free from any disease resembling swine plague; but the effect of being confined in a narrow pen, of being deprived of exercise, and of not receiving enough silica and lime in their food, commences to become apparent; one or more of them commenced to eat the feathers of their companions, and therefore were given their liberty.

May 10.—No essential changes, except as to pig No. 6, which is improving, and though yet very sick, has again commenced to eat.

May 11.—Pig No. 3, it seems, does not like its iodine, and for the last two or three days has not been eating and drinking as much as before, but shows no symptoms of swine plague. No. 9 appears to be slightly improving, but coughs now and then. No. 7 is moping, has poor appetite, and coughs. No. 2 is very vigorous, and greedy for its food and drink; it seems to like the carbolic acid.

May 12.—No change.

May 13.—The iodine treatment does not seem to agree with No. 3; it is, however, continued. The pig has not very good appetite, and drinks very little. No. 6 is improving and eats about half as much as a pig of its age and size ought to eat. No. 7 has less appetite.

May 14.—No. 2 is as well and as vigorous as ever. No. 3, which has coughed a few times during the last few days, drinks very little, and, though not eating enough, has a fair appetite, and is very lively. The pig is evidently not sick, at least does not show symptoms sufficient to justify one in pronouncing it diseased with swine plague. The iodine does not agree with it. No. 6 is slightly better; No. 7 is worse.

May 15.—Pig No. 7 does not touch its food, and is evidently worse; emaciation is visible. No change in any of the others.

May 16.—Pig No. 7 is still getting worse; does not eat anything; is very indifferent to its surroundings, and it takes some coaxing to induce it to get up.

May 17.—Pig No. 6 is improving. No. 7 accepts an egg, but does not take any other food. (As the chickens laid some eggs, I used the latter for experimental purposes, and also to tempt the appetite of some very sick pigs.)

May 18.—Pig No. 7 is slightly improving; it accepts another egg, eats some corn, and comes to the trough when water is poured in. No other changes.

May 19.—Pig No. 7 is improving; eats some, and is more lively. No. 6 can be considered as convalescent, and has fair appetite. No other pigs are ailing.

May 20.—Big rain and thunder storm during the night. Pig No. 7 is improving, and all other pigs are doing well, and are ready for another experiment, but no material of sufficient malignancy is available. One other chicken has scaly legs, but the mites, said to constitute the cause, are not found.

May 21.—All pigs are doing well. Nos. 6 and 7 are eating again, but their appetite is not yet fully restored. The carbolic acid and iodine treatment of pigs Nos. 2, 9, and 3, continued till date, is dispensed with.

May 22.—Pigs Nos. 2 and 9, not receiving any more carbolic acid, seem to miss its taste in their water for drinking, and do not seem to be satisfied. Pig No. 3, however, drinks more, and does not care for its dosis of iodine.

May 23.—No change. Pig No. 3, not getting any iodine, eats and drinks as well as any of the other pigs. One chicken with scaly legs, the one affected first, and for some time confined in pig pen No. 4, got into pen No. 6, and was killed by pig of the same number.

May 24.—Obtained new material at Mr. Philippi's place (*cf.* account of *post-mortem* examination No. 6), and inoculated at 5 o'clock p. m., pigs Nos. 2, 3, 9, 6, 7, 8 A and 8 B. Pigs Nos. 2, 3, and 7 receive three times a day a dosis of carbolic acid in their water for drinking; pigs

Nos. 8 A and 8 B are treated with benzoate of soda, while Nos. 9 and 6 receive no medicines whatever. No. 9 is the smallest, and No. 6 is the largest, of the pigs.

May 25.—Rain all day. All pigs seem to be doing well, and no apparent reaction has occurred from the inoculation. Nos. 6, 7, and 9, however, have not yet completely recovered. No. 9 especially has been coughing now and then since first affected, and does not seem to get over it; neither has it grown any, and is therefore small and runty.

May 26.—Again a heavy rain. None of the pigs ailing, except those which have not fully recovered.

May 27.—No change.

May 28.—None of the pigs show any symptoms of active disease, and all are doing well, except Nos. 9, 6, and 7.

May 29.—No change.

May 30.—Nos. 6, 7, and 9 cough some, and do not eat quite enough. The others are apparently healthy, and doing well.

May 31.—No. 9 is evidently worse, is coughing a good deal, and eats very little. The other pigs are doing well.

June 1.—No essential change in any of the pigs. No. 9 coughs considerably, and eats very little, but is otherwise lively.

June 2.—No. 9 again shows plain symptoms of active disease, is moping, coughs a good deal, and has very poor appetite, but is yet moving about. The other pigs are apparently healthy, at least are without any noticeable symptoms of active disease.

June 3.—No. 9 does not eat anything, and is very sick again. All others are doing well.

June 4.—No. 9 commences to eat a little.

June 5.—No. 9 improving, is more lively, and eats more than yesterday. No change in the others.

June 6.—No. 9 improving; eats more than on any one day during the last ten days, and is more lively, but is lean and coughs quite often. Other pigs doing well.

June 7.—All pigs eat well, and with the exception of No. 9, which is yet coughing, none of them exhibit any symptoms of disease.

The medicines, carbolic acid to Nos. 2, 3, and 7, and benzoate of soda to Nos. 8 A and 8 B, are dispensed with. Pigs Nos. 8 A and 8 B, which received the benzoate of soda, did not seem to object to it, and do not show any bad effect, except a slight diarrhea, which made its appearance soon after the treatment was commenced, and continued as long as the medicine was given.

June 8.—No changes.

June 9.—As it becomes apparent that a pig which once had swine plague does not easily take it again, or, if it does, only in a mild form, I found it necessary to procure new pigs, and bought four nice Berkshires, all sow pigs, belonging to the same litter, and nearly three months old, of the Hon. James R. Scott, of Champaign.

June 10.—No change; one of the chickens, the best one, is missing, and was probably stolen.

June 11 to 14.—No changes worth mentioning, except that pig No. 9 has diarrhea and coughs a good deal.

June 15.—Received my pigs from Mr. Scott; designated the same as Nos. 10, 11, 12, and 13, and put them all four together in a box-stall of the Veterinary Infirmary of the Illinois Industrial University.

June 16.—Succeeded in procuring fresh material for inoculation in Mr. Carson's herd, five miles southeast of Tolono (*cf.* account of *post mortem* examination No. 7), and inoculated at 6 o'clock p. m. pigs Nos.

2, 3, 9, 6, 7, 8 A, 8 B, 10, 11, and 12. Pigs Nos. 1 A, 1 B, and No. 13, the latter being one of the new pigs, were not inoculated. All pigs, with the exception of No. 9, which is yet ailing, are apparently well.

June 17.—All pigs seem to be well, except No. 9, which is yet coughing considerably, but has a fair appetite. No. 6, too, appears to be not very lively; the same struggled hard while held for inoculation and got slightly hurt.

June 18.—No change; No. 6 is a little dull, and acts as if not feeling well.

June 19.—No change.

June 20.—All pigs eat well, and none of them show any symptoms of disease, except No. 9, which has never fully recovered, and No. 6, which is yet lame and less lively than usual.

June 21.—Nos. 10, 11, and 12 seem to be slightly indisposed; have lost the curl out of the tail, but eat and drink some.

June 22.—All pigs—partly due, perhaps, to exceedingly hot weather—eat less than usual, but Nos. 9, 10, 11, and 12 eat very little; the last three especially do not seem to care for food (their principal food consists of ground corn and ground oats mixed), and prefer to lie down and rest.

June 23.—Nos. 10 and 11 have not eaten anything since last night; No. 12 has been at the trough, but has eaten very little, if any. The other inoculated pigs, Nos. 2, 3, 9, 6, 7, 8 A, and 8 B, also seem to lack appetite; at any rate, they do not consume more than about half their usual quantity of food. Whether the want of appetite is caused by the inoculation having been effective or merely by the high temperature is difficult to decide.

June 24.—Pigs Nos. 10, 11, and 12 have not eaten anything, and No. 13 commences to show poor appetite. (No. 13 was not inoculated, but occupied the same pen—the box-stall in the infirmary building—as Nos. 10, 11, and 12, and eats and drinks out of the same trough and partakes of the same food and water.) All four commence to huddle together in a corner and to hide their noses in the bedding, in sick-pig fashion. Some of the dung found in their pen is in shape of small, hard, irregular lumps, and very dark colored. As to the other pigs no conspicuous changes are observable. No. 9, which never fully recovered, is coughing some, and eats very little. The others, too, with the exception of Nos. 1 A and 1 B, which have not been inoculated, show diminished appetite.

June 25.—Pigs Nos. 10, 11, and 12 have not touched their food; have commenced to emaciate and are getting thin. No. 13, too, has poor appetite and eats very little. Removed pig No. 10 to the empty pen No. 4 in the experimental pig-pen, which was first thoroughly scrubbed and cleaned. Commenced treating pigs Nos. 11, 12, and 13 with carbolic acid by giving it to them in their water for drinking. It may here be remarked that Nos. 11 and 12 have shown symptoms of sickness for at least four or five days (since the 21st), and are undoubtedly diseased with swine plague. No. 13, although not inoculated, was also ailing for two days and suffering from the same disease. In giving the carbolic acid it was my object to try that medicine on a few well-established cases of swine plague. No. 10 does not receive any medicine whatever. As to the other pigs, they do not eat much, but seem to be perfectly healthy, except Nos. 1 A and 1 B, but none of them, except No. 9, exhibit any plain symptoms of swine plague. No. 9 is about the same as it has been for some time, and is neither worse nor better. The symptoms exhibited seem to be the product of old morbid changes, and not of any active morbid process.

June 26.—Pigs Nos. 10, 11, and 12 are very thin, and do not touch their food. No. 10, which occupies by itself pen No. 4, is the thinnest, and shows considerable weakness in its movements. No. 13 has poor appetite and eats but little.

June 27.—Pigs Nos. 10, 11, 12, and 13 take a little shelled corn, but do not eat their chopped food. Nos. 11, 12, and 13 accept and consume an egg.

June 28.—Heavy rain during the night. Pig No. 10 is very low, coughs a great deal, and is apparently in distress. Nos. 11, 12, and 13 have eaten a little, and again consume an egg. Another egg offered to No. 10 is refused. The other pigs about the same, only Nos. 8 A and 8 B eat less than any of the rest. No. 9 is coughing; have heard no cough from Nos. 11, 12, and 13.

June 29.—Pigs Nos. 1 A and 1 B all right in every respect. Nos. 2, 3, 6, 7, 8 A, and 8 B without any plain symptoms of disease, and appetite improved. Pig No. 10 worse and coughing, and does not eat anything whatever, and Nos. 11, 12, and 13 hardly touch their food.

June 30.—No. 10 has diarrhea, and lies all day almost motionless in its favorite corner. An egg put in the pen has disappeared, and must have been eaten. Nos. 11, 12, and 13 hide in their bedding, as usual, and it takes considerable coaxing to induce them to get up. All others the same as before.

July 1.—No. 10 very low; has much diarrhea, and does not get up unless compelled. Nos. 11, 12, and 13 eat a trifle. No. 11 has diarrhea, and all have a tendency to hide their heads in the bedding; none of them cough. All other pigs without any change. During the night another heavy rainfall.

July 2.—No. 10 eats a little shelled corn, and seems to be more lively. Nos. 11, 12, and 13 also appear to be a little better and eat some chopped food (a small handful) and a little young clover. All seem to be slightly better and more lively; at least none are worse. At noon No. 12 was licking the floor (vitiated appetite, a frequent symptom), and a few drops of carbolic acid poured down were greedily licked up.

July 3.—All the smaller pigs—Nos. 10, 11, 12, and 13—have diarrhea. No. 10 coughs, but not often. Have heard none of the others cough. No. 9 has somewhat better appetite, but is otherwise the same as before.

July 4.—No perceptible change.

July 5.—All of the small pigs eat just a mere trifle. No change.

July 6.—No change whatever.

July 7.—No. 10 eats a little, but is very dumpish and weak. Nos. 11, 12, and 13 have a bad diarrhea, and the first two are very much emaciated. All three eat just a mere trifle, but do not seem to be thirsty, while No. 10 commences to drink a good deal. No. 13, too, begins to act a little dumpish, but less so than No. 10; while No. 11, apparently the sickest pig in the lot and surely the most emaciated, is the liveliest, and not dumpish at all.

July 8.—No change since yesterday. No. 10, is very thirsty and eats a little shelled corn. Nos. 11, 12, and 13 have not touched their food, except in the evening, when the three together consumed half a handful of corn-meal and ground oats mixed with water.

July 9.—No change. At 11 o'clock a. m. a tremendous storm.

July 10.—Pig No. 10 has diarrhea and is very weak. Nos. 11, 12, and 13 are also getting very weak. No. 10 is thirsty and eats some shelled corn.

July 11.—No. 10 appears to be blind; it is very thirsty; its appetite is rather increased, at least not diminished, but its excrements are almost as thin as water. No. 11, although the most emaciated, eats, perhaps, more than either Nos. 12 or 13, which eat next to nothing. All have diarrhea.

July 12.—No. 10 about the same as yesterday, perhaps more dumpish. Nos. 11, 12, and 13 emaciate rapidly and hardly touch their food. All have diarrhea, but the discharges have yet a white yellowis color. All other pigs without any change.

July 13.—No. 10 the same as yesterday, but more loath to get up, and slower and more undecided in its movements. Nos. 11, 12, and 13 more emaciated, and more diarrhea. All four pigs exceedingly weak, and scarcely able to stand upon their legs. The others are unchanged and apparently well, except No. 9, which is coughing, as usual.

July 14.—No. 10 very weak and trembling to and fro when rising. No. 12, which was originally the best and strongest pig of the four, and is less emaciated than any of the others, appears to-day to be the worst of all; it had a bad sneezing fit. No. 11 is exceedingly poor, but more active than any of the others. Nos. 11 and 13 eat a little in my presence, but No. 12 cannot be prevailed upon to touch the choicest food—an egg and some young and juicy clover. Nos. 10, 12, and 13 have been dumpish for several days and act as if their livers were affected. The weather is very hot and sultry, and the thermometer shows 100° F. in the shade.

July 15.—No visible changes in Nos. 10, 11, and 13, except that the two latter—due, probably, to the cooler weather—show a little more liveliness and eat a trifle. No. 12, though the least emaciated, and originally the best and strongest pig, is to-day decidedly the sickest; it reels and staggers and is scarcely able to stand. It has again had a violent sneezing fit. No. 11, too, is very weak and can hardly stand, but acts more lively than yesterday.

July 16.—Nos. 10 and 12 exceedingly weak, and can rise and stand only with difficulty. Neither of them touch their food. No. 10 drinks some. No. 12 had another severe sneezing and coughing fit, and has undoubtedly lung worms (*Strongylus paradoxus*). No. 13 eats a little and drinks a good deal. The urine of No. 12 is of a yellowish-brown color.

July 17.—Pigs Nos. 11 and 13 a trifle livelier, and eat and drink some. No. 12 evidently still worse, and perfectly blind; one eye is closed entirely, and the other nearly so. No. 10 is very thirsty, and otherwise the same as before. Pig No. 3 is unusually quiet; but eats and drinks well.

July 18.—Pigs Nos. 11 and 12 more lively, but to the utmost emaciated, especially No. 11, which is nothing but skin and bones. No. 12 drinks a little, but takes no food, and cannot rise without assistance. No. 10 is declining more and more, and its diarrhea is getting fetid. Of late it has been drinking considerably, but has not taken any food, and cannot be prevailed upon to get up. No. 9 is still coughing, but eats its food; and No. 3, formerly a noisy pig, remains unusually quiet, but has good appetite, and shows no symptoms of disease. All others apparently healthy.

July 19.—Pig No. 10 discharges a large number of worms (*Ascarides*); No. 11 is exceedingly weak, No. 12 has violent coughing fits, and No. 13 is improving.

July 20.—No. 10 is very weak; has eaten very little, if anything, since last night, and don't seem to have as much desire to drink. No. 11 is so weak as to fall down when slightly pushed while standing. No. 12 is exceedingly dumpish, emaciates very fast, and has no appetite whatever. No. 13 is improving. Killed No. 11 by bleeding at 8 o'clock a. m. (*cf.* account of *post mortem* examination No. 9). Inoculated at noon pigs Nos. 1 *a*, 2, and 3 with the pulmonary exudation of pig No. 11.

July 21.—Pig No. 10 exceedingly weak and very dull, but eats and drinks some. Pig No. 12 is very low; will rise only if helped on its legs, and then immediately lies down again. Pig No. 13 decidedly improving, is getting frisky, eats some, and drinks a good deal. All other pigs as usual.

July 22 and 23.—Hardly any change in any of the pigs, except No. 13, which is getting better, and gaining strength and appetite.

July 24.—Pig No. 10 died in the forenoon (*cf.* account of *post mortem* examination No. 10). Pig No. 12 is very low, and hardly able to move, when helped on its legs. No. 13 is improving.

July 25.—Pig No. 12 very low. No. 13 eats and drinks well, and although very lean, hardly anything but skin and bones, is lively and even playful. All other pigs are doing well.

July 26.—No essential changes. Pig No. 12 cannot walk, but took some water when carried to the trough. All other pigs doing well.

July 27.—Pig No. 12 dead at noon (for morbid changes see account of *post mortem* examination No. 11). No changes visible in any of the other pigs.

At this date my experiments became interrupted by sickness, and my experimental pigs, Nos. 1 A, 1 B, 2, 3, 9, 6, 7, 8 A, 8 B, and 13, were taken care of by Mr. Seymour, a student of the Illinois Industrial University, till August 4, and after that date by Mr. Lawrence, head farmer of the same University. According to Mr. Seymour none of the pigs showed any symptoms of active disease on August 4; so it must be supposed that the inoculation of pigs Nos. 1 A, 2, and 3, made July 20, was not followed by any new attack. In the afternoon of August 4, a very hot day, the pigs, with the exception of No. 13, were removed from the experimental pig-pen to the University farm. Pigs Nos. 6 and 7, two large sows, both in good condition, but weak and very much damaged by swine plague—both of them had a severe attack, and I have reason to suppose that nearly half of the tissue of their lungs was degenerated (hepatized)—it seems have been roughly handled by Mr. Lawrence's hired man, who removed them; at any rate, one of the sows died the same day, and the other one next morning. A *post mortem* examination was not made.

Pig No. 13 was cared for by Mr. Leal during my sickness, and kept on his premises, where it was fed with kitchen offal and corn.

On August 21 I was able to resume my work, engaged new pigs, looked about for suitable material for inoculation, and made arrangements to have my experimental pig-pen moved away from the University grounds to a private lot belonging to Mr. Leal, who gave me permission to do so. The moving of the pig-pen had become necessary, because during my sickness the Veterinary Infirmary building, in which I had to get the water for my pigs, had been moved to another place, which deprived me of water.

August 23.—Bought four very nice and perfectly healthy Berkshire pigs, belonging to the same litter, about 3 months old, of Hon. J. R. Scott, of Champaign.

August 25.—Received my pigs from Mr. Scott, and, as my pig-pen had not yet been moved, put them temporarily in Mr. Leal's cow-shed. They were then numbered 14, 15, 16, and 17. After several fruitless attempts to obtain material, I visited diseased herds of swine on August 22, 23, and 24, but found the disease everywhere of such a mild character that

I did not deem it expedient to take any material for inoculation and other experimental purposes. I succeeded in getting material at Mr. Bailey's farm (*cf.* account of *post mortem* examination Nos. 12 and 13). Inoculated at 5 o'clock p. m., in the usual way and with material (lung-exudation) of Mr. Bailey's pig No. 1 (old experimental pig), No. 13, and new pigs Nos. 14, 15, and 16. Pig No. 17, the smallest of the lot, had escaped from the cow-shed, and was not inoculated.

August 26 and 27.—No reaction.

August 28.—Succeeded in getting the experimental pig-pen moved to Mr. Leal's grounds, and disposed the pigs as follows: No. 13 in pen No. 6, No. 14 in pen No. 3, No. 15 and No. 16 in pen No. 4, and No. 17, the one not inoculated, in pen No. 7. No change and no reaction in any of the pigs.

August 29.—Commenced carbolic acid treatment with pigs Nos. 15 and 16, and gave three times a day, each time about 9 or 10 drops of a 95 per cent. solution to the two pigs. Pigs Nos. 13 and 14 received no medicines. All pigs apparently healthy, except No. 13, which is yet thin, has not grown any, and is still suffering from the morbid changes left behind by its severe attack of swine plague in July. It has, however, a good appetite, and is lively and active.

August 30.—No changes.

August 31.—Received back from Mr. Lawrence the old experimental pigs Nos. 1 A, 1 B, 2, 3, 9, 8 A, and 8 B. Nos. 6 and 7 had died on his hands on August 4, 5, respectively, as mentioned before. All pigs are doing well, but have grown very little, if any. No. 9 is still coughing occasionally, and suffering from the morbid changes left behind by its continued attack of swine plague. It is small and runty. After a very droughty season of several weeks' duration the first rain occurred to-day.

September 1.—All pigs doing well; heard Nos. 14 and 15 cough. It is raining.

September 2.—More rain. No change observable in the pigs.

September 3.—Very big rain. Pigs Nos. 14 and 13 do not seem to have as good appetite as usual—do not eat much. All other pigs are well.

September 4.—No change in any of the pigs.

September 5.—Heavy dew in the morning. None of the pigs show any plain symptoms of active disease; No. 14, though, does not eat well—eats about half a meal.

September 6 and 7.—No essential change.

September 8.—Pigs all right, except No. 14, which has poor appetite, and is not as lively as the others. It was at first slightly the largest and heaviest, but is not now.

September 9.—No essential change. The weather is cold and clear. Carbolic acid treatment of pigs Nos. 15 and 16, which are doing well in every respect, and always hungry, is discontinued.

September 10.—All pigs doing well, except No. 14, which every day eats some, but has a very unsatisfactory appetite, and is not near as active and lively as any of the others of the same litter. It is somewhat emaciated, and is now the smallest of the young pigs. No. 13 is active and has good appetite, but on account of the old morbid changes does not grow and improve in flesh. Found a small abscess on the right ear of pig No. 13, at the point at which the inoculation was made. The abscess—about as large as a small hazel-nut—contained thick, whitish matter. Pigs Nos. 13 and 14 cough occasionally.

September 18.—Not being able to obtain suitable material for inoculation and other experimental purposes in the neighborhood of Champaign, I went to Effingham county, where swine plague was reported to be existing in a malignant form, and obtained some at I. Martin's place, near Mason (see *post-mortem* examination No. 14), and inoculated, on

September 19, Pigs Nos. 1 A, 1 B, 2, 3, 8 A, 8 B, 9, 13, 14, 15, and 16. Pig No. 17 was not inoculated. Performed the operations in the following manner: The tip of the pig's ear was taken in the left hand, and the point of a narrow-bladed knife, pointing toward the root of the ear, was inserted about half an inch deep, between the external skin and the cartilage of the ear, so as to form a small pocket. The knife withdrawn, a pipette, containing lung-exudation, was inserted in the pocket, the latter a little deepened by slight pressure upon the pipette, and a few drops of exudation dropped in by withdrawing the pipette. Commenced again at noon to give three times a day, each time about 9 or 10 drops of carbolic acid to pigs Nos. 15 and 16. The other pigs do not receive any medicine. No. 14 has very poor appetite, and is thin in the flanks and somewhat emaciated, yet eats a little at every meal, and, though evidently diseased, does not seem to be very sick.

September 20.—No change.

September 21 to 30.—No essential change in any of the pigs. All the older pigs especially do not seem to react in the least upon the inoculation. Pigs Nos. 14, 15, and 16, but particularly the first (No. 14), show somewhat diminished appetite. No. 14 has considerably emaciated, and is thin, but No. 15 and 16 are in very good condition and have not lost any flesh; they are as round and chubby as before, but have not grown much. The carbolic acid treatment was continued till September 30, at which date it was stopped.

October 1 to 12.—No change. All pigs are doing well, and none of them show any symptoms indicating the existence of acute disease.

October 13.—Again had to go to Effingham county for fresh material, and obtained some at the farm of Mr. Munday, who lives between Effingham and Watson (*cf.* account of *post-mortem* examination No. 15), and inoculated, on arriving at my experimental station at 4 o'clock p. m., pigs Nos. 13, 14, 15, 16, and 17 in the old manner, by means of a small inoculation needle. No. 17 had never been inoculated before.

October 14.—Fed the lungs, some lymphatic glands, and other tissues of Mr. Munday's pig, to pigs Nos. 1 A, 1 B, 2, 3, 8 A, 8 B, and 9.

November 3.—As none of the experimental pigs have shown any symptoms of active disease, I concluded to obtain fresh material from some other place, and went to Oquawka, Henderson county, Illinois, where, according to information received, swine plague was prevailing in a malignant form.

November 4, 5, and 6.—Visited several herds, and finally procured material at Mr. Beaty's farm (*cf.* account of *post-mortem* examination No. 16), on November 6. Starting for Champaign, or rather Urbana, immediately, I arrived there in the night.

November 7.—Inoculated in the usual manner pigs Nos. 13, 14, 15, 16, and 17, giving each pig four punctures. The right lobe of the lungs and some other morbid tissues of Mr. Munday's pig were fed to the older experimental pigs, and the left lobe was photographed (see photograph, Plate III). Next day I had to leave for Chicago, and left the pigs under the superintendence of my friend, Prof. F. W. Prentice, M. D., of the Illinois Industrial University. On November 17 I received notice of one of the pigs being sick, and went to Champaign on November 20, when I found pig No. 17 coughing, short of breath—each respiration causing a slight pumping motion of the flanks—and shivering. Pig No. 13 had died. This pig, as has been related, had a severe attack of swine plague in July, and since that time had been inoculated four times (August 25, September 19, October 13, and November 7) without effect, but the morbid changes left behind by the first attack caused it to be very weak, and evidently interfered with the process of nutrition. The pig remained poor and did not grow. By the very cold weather of the last few days one of its feet, it seems, became frozen, and its penmate, pig No. 14 (it must be mentioned that pig No. 13 had to give up its pen to one of the older pigs, when the latter was returned by Mr. Lawrence, and was put together with No. 14), though a younger pig, but heavier and stronger, probably attacked and wounded the frozen foot. The frost did the rest. On the morning of the 18th of November pig No. 13 was found dead, frozen stiff, and the toes of one foot partially eaten off. The *post-mortem* examination, which was made November 20, was very difficult on account of the frozen condition of the carcass. The morbid changes found consisted, besides considerable swelling, of congestion and inflammation in one foot and leg, and other effects of freezing, exclusively of such as were left behind by the attack of swine plague in July, and were as follows:

In the chest evidences of old hepatization in both lobes of the lungs, extending in the right lobe to about one-fifth or one-sixth, and in the left one to about one-third of the whole lung tissue, and some serum in the chest and in the pericardium. In the abdominal cavity considerable enlargement of the liver, and in the interior of that organ in several places cavities (dilatations) in the hepatic ducts. These dilatations presented themselves as roundish and oval cavities of the size of a hazelnut, and, it must be presumed, have been caused and been occupied by worms (*cf. post-mortem* examination of two of the mates of this pig—experimental pigs Nos. 10 and 12).

All other experimental pigs appeared to be healthy. Nos. 1 A, 1 B, 2, 3, 8 A, 8 B, and 9, being of no more use as experimental pigs, were sold on November 20, and taken away on November 24.

Visited my experimental pigs again on December 1, and found pig No. 17 very thin, though not very much emaciated, and yet ailing; No. 14 was still poor, and Nos. 15 and 16 all right in every respect.

SUMMARY.—PIG NO. 1 A.

April 12.—Received a few drops of dried blood (of Mr. Dillon's pig) in its water for drinking.

May 3.—Inoculated with swine plague schizophytæ, cultivated in albumen.

July 20.—Inoculated with lung-exudation.

September 19.—Inoculated with lung-exudation.

October 14.—Fed with morbid tissues.

November 7.—Fed with morbid tissues. (This pig never showed any *plain* symptoms of swine plague, and it is doubtful whether it had a slight attack in April or not.)

PIG NO. 1 B.

April 12.—Received, together with 1 A, a few drops of dried blood (of Dillon's pig) in its water for drinking.

April 18.—Showed first symptoms of a mild attack of swine plague, from which it soon recovered.

May 3.—Inoculated with swine plague, schizophytæ cultivated in albumen.

September 19.—Inoculated with lung exudation.

October 14.—Fed with morbid tissues.

November 7.—Fed with morbid tissues.

PIG NO. 2 A (afterwards No. 2).

April 14.—Inoculated with swine-plague schizophytæ, cultivated in fresh milk.

April 24.—First symptoms of a mild attack, from which it soon recovered.

May 1.—Inoculated with lung-exudation.

May 7-21.—Treated with carbolic acid.

May 24.—Inoculated with lung-exudation.
May 24 *to June* 8.—Treated with carbolic acid.
June 16.—Inoculated with lung-exudation.
July 20.—Inoculated with lung-exudation.
September 19.—Inoculated with lung-exudation.
October 14.—Fed with morbid tissues.
November 7.—Fed with morbid tissues.

PIG NO. 2 B (afterwards No. 9).

April 14.—Inoculated with swine-plague schizophytæ, cultivated in water.
April 24.—First symptoms of a mild attack of swine plague.
May 1-21.—Treated with carbolic acid.
May 3.—Transferred to pen No. 5, in which pig No. 5 had died, and thus exposed to infection.
May 7.—Increased symptoms of disease.
May 24.—Inoculated with lung-exudation.
May 31.—Increased symptoms of swine plague; the disease assumes a chronic form.
June 16.—Inoculated with lung-exudation.
September 19.—Inoculated with lung-exudation.
October 14.—Fed with morbid tissues.
November 7.—Fed with morbid tissues. (This pig never fully recovered, but had no plain relapse after June 1.)

PIG NO. 3.

May 1.—Inoculated with lung-exudation.
May 1-21.—Treated with iodine-solution.
May 24.—Inoculated with lung-exudation.
June 16.—Inoculated with lung-exudation.
July 30.—Inoculated with lung-exudation.
September 19.—Inoculated with lung-exudation.
October 14.—Fed with morbid tissues.
November 7.—Fed with morbid tissues. (Pig never showed any plain symptoms of swine plague.)

PIG NO. 4.

April 7.—Inoculated with lung-exudation.
April 12.—First plain symptoms of swine plague.
April 24.—Death.

PIG NO. 5.

April 7.—Inoculated with lung-exudation.
April 11.—First plain symptoms of swine plague.
April 30.—Death.

PIG NO. 6.

April 29.—First plain symptoms of swine plague.
May 24.—Inoculated with lung-exudation.
June 16.—Inoculated with lung-exudation.
August 4.—Death from over-exertion in hot weather.

PIG NO. 7.

April 12, 15, 19, 22.—Fed with swine-plague schizophytæ, cultivated in albumen.
April 25.—First plain symptoms of swine plague.
May 24.—Inoculated with lung-exudation.
June 16.—Inoculated with lung-exudation.
August 5.—Death from over-exertion in hot weather.

PIG NO. 8 A and PIG NO. 8 B.

May 24.—Inoculated with lung-exudation.
May 24 *to June* 8.—Treated with benzoate of soda.
June 16.—Inoculated with lung-exudation.
September 19.—Inoculated with lung-exudation.
October 14.—Fed with infectious material (morbid tissue).
November 7.—Fed with morbid tissue.

PIG NO. 10.

June 16.—Inoculated with lung-exudation.
June 21.—First plain symptoms of swine plague
July 24.—Death.

PIG No. 11.

June 16.—Inoculated with lung-exudation.
June 21.—First plain symptoms of swine plague.
June 25.—Commenced treatment with carbolic acid.
July 20.—Death.

PIG No. 12.

June 16.—Inoculated with lung-exudation.
June 21.—First plain symptoms of swine plague.
June 25.—Treatment with carbolic acid commenced.
July 27.—Death.

PIG No. 13.

June 24.—First plain symptoms of swine plague.
June 25.—Treatment with carbolic acid commenced.
August 25.—Inoculated with lung-exudation.
September 19.—Inoculated with lung-exudation.
October 13.—Inoculated with lung-exudation.
November 7.—Inoculated with lung-exudation.
November 18.—Death caused by frost.

PIG No. 14.

August 25.—Inoculated with lung-exudation.
September 8.—First symptoms of a mild attack of swine plague.
September 19.—Inoculated with lung-exudation.
October 13.—Inoculated with lung-exudation.
November 7.—Inoculated with lung-exudation.

PIG No. 15 and PIG No. 16.

August 25.—Inoculated with lung-exudation.
August 29 *to September* 9.—Carbolic-acid treatment.
September 19.—Inoculated with lung-exudation.
September 19–30.—Carbolic-acid treatment.
October 13.—Inoculated with lung-exudation.
November 7.—Inoculated with lung-exudation. (The two pigs never exhibited any plain symptoms of swine plague.)

PIG No. 17.

October 13.—Inoculated with lung-exudation.
November 7.—Inoculated with lung-exudation.
November 20.—Plain symptoms, but probably not the first, of a mild attack of swine plague.

RESULTS OF EXPERIMENTS.

The results of these experiments are in perfect accord with my former observations, and do not show that swine plague is or will be communicated through the whole (not lesioned) skin, or through the uninjured respiratory mucous membranes of a healthy animal, even if it is surrounded by and has to breathe the same atmosphere in which an animal diseased with swine plague is breathing. As early as April 12 I had two genuine and malignant cases of swine plague (both had a fatal termination) in my experimental pig-pen in which all pigs, eleven in number on that date, were under one roof, separated only by rough board partitions, none too tight, and not more than 3 feet 10 inches high. Moreover, I inoculated first those pigs which occupied the two south pens, Nos. 4 and 5, knowing that in the spring and summer more wind must be expected from the south and from the southwest than from any other direction. The effluvia from the sick pigs, therefore, was driven almost constantly into the other pens. Afterwards pigs Nos. 4 and 5 died, and both pens were again occupied by two very sick pigs; pen No. 4 by pig No. 10, which died after about a month's illness, and pen No. 5 by pig No. 9, in which the disease became chronic. Notwithstanding all this, none of the pigs not inoculated or otherwise purposely infected and *free from external sores or wounds* became infected. It is true pig No. 6 contracted swine plague before it had been inoculated by occupying pen No. 6, which joins No. 5, but pig No. 6 had a sore nose; it had been ringed, and external sores, as has before been shown, are liable to attract and absorb the swine-plague schizophytæ, which may happen to be floating in the air, even if the diseased animals from which they come are quite a distance off. Pig No. 13, too, became infected by association with pigs Nos. 10, 11, and 12 (all three inoculated and diseased) in the same pen, but all four pigs had to eat and to drink out of the same trough, and all, pig-fashion, not only soiled their noses with their own excretions and those of their companions, but also put their dirty feet into the trough at every meal. Hence, it is more than probable that pig No. 13 consumed food and water contaminated with an abundance of swine-plague schizophytæ, voided or discharged with the excrements and urine of the inoculated and diseased pigs, and may be also with their saliva and mucus discharges from the nose. The case of pig No. 13 proves also another thing, viz., that swine plague can be communicated, and that swine-plague schizophytæ are already discharged during the stage of colonization (period of incubation), or before plain morbid symptoms can be observed, because, as appears from the accounts of pigs Nos. 10, 11, 12, and 13, the latter must have become infected before the others showed any plain symptoms of disease, or the stage of colonization must have been an uncommonly short one in pig No. 13. All four pigs, as has been mentioned, were raised by the Hon. J. R. Scott, president of the Illinois State Board of Agriculture, and the rest of the litter, five pigs, are yet, at any rate a few weeks ago, in his possession, and have never been ailing. Neither has Mr. Scott had any disease among his swine for over a year, and may be for over two years. So the animal cannot have been infected when I received it.

2. The value of carbolic acid and of other antiseptics as preventives of swine plague, if used in time, immediately after an infection has taken place, and before any morbid changes have developed, has been confirmed by the results of my experiments (*cf.* account of experimental pigs Nos. 2 A, 2 B, 3, 7, 8 *a*, 8 B, 15, and 16). It is true, Nos. 2 A and 2 B (the latter not fully) had recovered from a mild attack of swine plague, brought on by an inoculation with cultivated schizophytæ, when the second inoculation was made and the carbolic-acid treatment commenced with, and if such a mild attack is, in a majority of cases, sufficient to produce immunity, as seems to be the case, it is possible that pig No. 2 A might not have contracted the disease after the second inoculation if no carbolic acid had been used. Pig No. 2 B had not fully recovered. The morbid process was yet active, and morbid changes were existing when subjected to the carbolic-acid treatment, and the carbolic acid, it seems, had the effect of checking the impetus which the morbid process received when the animal was transferred to the thoroughly infected pen No. 5, and compelled to eat the food left there, which had been contaminated by pig No. 5. Pig No. 2 B was thus exposed to a very severe infection, which, due undoubtedly to the carbolic acid treatment, had very little effect, although the animal evidently had not lost its predisposition, because, after a third far less severe and lasting infection inoculation on May 24, an exacerbation became visible May 31. Pig No. 7 had recovered from a rather severe attack, when it was inoculated with lung-exudation on May 24, and subjected to the carbolic-acid treatment; it is therefore possible, and even probable, that the inoculation, on account of the previous attack, would have remained

ineffective, if no carbolic acid had been used. The same, after another inoculation, made June 16, had its appetite disturbed, and may have had a very slight attack, but the latter is doubtful. There exists, however, no uncertainty in regard to pigs Nos. 15 and 16. They were treated with carbolic acid soon after the first inoculation, and neither the first nor any of the three subsequent inoculations (*cf.* account of those pigs) produced any morbid changes. I saw those pigs again on December 1, and found them thrifty, healthy, and in a good condition, which proves that they never suffered from swine plague, because every attack, no matter how mild, always leaves some traces behind, and more or less retards the growth and development of the animal. Every other one of the experimental pigs that contracted the disease and recovered, even pig No. 1 A, of which it is not certain whether it had a mild attack or not, but probably had after the first infection, has become more or less stunted, and is not near as thrifty as a healthy pig.

The carbolic-acid treatment, however, is of not much use it not commenced with before plain symptoms of swine plague have made their appearance, or, what is the same, before serious morbid changes have been produced (*cf.* account of experimental pigs Nos. 11, 12, and 13), because the carbolic acid cannot repair those morbid changes which, in many cases at least, very soon develop sufficiently to make a continuation of life impossible, or to cause death by exhaustion, even if the activity of the morbid process is interrupted, or its cause removed or neutralized before the disease has reached its acme or greatest violence (*cf.* account of *post-mortem* examination No. 9 of pig No. 11). It must be mentioned, however, that pigs Nos. 11, 12, and 13 were very irregular in drinking, and took but very little food while sick, therefore they did not regularly consume their allotted doses of carbolic acid, and on several days took next to nothing, or not anything at all.

Benzoate of soda was tried, and proved to be a good preventive (*cf.* account of pigs Nos. 8 A and 8 B), but its high price forbids its use in a large herd of swine.

The iodine treatment of pig No. 3 has also given very good results, but experimenting with iodine was not continued, because it was found that a continued use of iodine interferes with the organic change of matter, decreases the secretions and excretions, and seriously diminishes the appetite and the desire to drink; consequently a continued use of iodine, it must be supposed, will materially reduce the growth and thriftiness of the animal.

More experiments with preventives might have been made, and those made might have been repeated, but to do so would have required a large number of experimental pigs, and besides that, it was nearly always, and particularly in the latter part of the season, very difficult to procure reliable material (from a malignant case) when wanted. Those places where the disease, according to the best information obtainable, was existing in a malignant form—the central part of Northern Iowa, for instance—were too far off, and to move the experimental station would not only have been expensive, but would also have caused much loss of time. Besides that, the first symptoms of the disease are well known by nearly every one, and wherever it makes its appearance the farmers, as a rule, hasten to sell off every pig they have on the place; hence a great scarcity of reliable material even in badly infected districts.

3. The results of my experiments corroborate the correctness of my former observations, that a healthy pig, one that never had swine plague, will almost invariably contract that disease if inoculated with the lung-exudation of a pig affected with swine plague, provided no measures of

prevention are applied. I say "almost" invariably, because experimental pig No. 17 apparently makes an exception; it did not take the disease after the first inoculation with material from Mr. Munday's pig, and it seems that several circumstances combined to make that inoculation ineffective. In the first place, pig No. 17 seemed to possess an uncommon resistibility, or very little predisposition, because it took the disease only in a very mild form after the second inoculation with material from Mr. Beaty's pig. Secondly, the material used for the first inoculation, although the best I was able to obtain, was from a pig which had a comparatively mild attack, had been ailing for some time, had passed the height of the disease, had regained more or less appetite, and was already recovering, or, at least, was better than it had been. The material (lung-exudation), therefore, may have lacked sufficient vigor, although swine-plague schizophytæ were present. Other schizophytæ, *bacteria termo* and *bacteria lineola*, however, also made their appearance in an uncommonly short time (see drawings), and although not found in the lung-exudation when the inoculation was made, it is not certain, judging by later developments, that their germs did not exist, and it is not impossible that the same, if existing, may have interfered with a proper development of the swine-plague schizmoycetes. In explanation it must be stated that I had a new, large, and perfectly clean salt-mouthed bottle with a new rubber stopper when I went to Mr. Munday's place, but when ready to make the *post-mortem* examination, I found that the bottle, which was in a satchel, had become broken in the wagon on the rough roads. I was therefore obliged to procure from Mr. Munday another bottle for the morbid tissues I wished to take with me, and obtained one which had been used for preserves, and, although carefully rinsed with water, may have contained, hidden in the cork perhaps, some *termo* and *lineola* germs.

The results of my experiments show further that an attack of swine plague of which the animal recovers produces immunity from the effect of subsequent infections in most cases, but not in all. Some pigs will contract the disease a second and even a third time, especially if inoculated, or exposed to an infection before they have fully recovered (*cf.* account of experimental pig No. 2 B, afterwards No. 9), but the second or third affection, it seems, is always a comparatively mild one, and does not become fatal. Hence the first affection with swine plague gives the animal, after its recovery, always some protection against a subsequent infection by mitigating the morbid process, and, in many, perhaps a large majority of cases, produces an almost complete immunity. I say "an *almost* complete immunity," because a pig that has recovered from an attack of swine plague will usually show some slight reaction if again inoculated or otherwise infected, although no morbid changes may be produced (*cf.* the summary of experiments which shows how often, and at what times each one of the experimental pigs was inoculated and fed with infectious material, and that only one of the pigs which survived the first attack contracted the disease oftener than once, and each time before it had fully recovered).

4. The two inoculations with cultivated material, swine plague schizophytæ cultivated in milk and in water respectively, proved to be effective, and, the same as in former cases, were followed by a mild attack. Such, therefore, seems to be the rule, and as there can be no doubt that an affection with swine plague, resulting from an inoculation with cultivated material, will afford just as much protection against subsequent infection as any other attack of swine plague caused by an inoculation with material directly from the body of a sick hog, or by natural infec-

tion; inoculations with cultivated material might be made use of for the purpose of lessening the losses caused by the plague. But whether such inoculations can be recommended from a practical standpoint is quite another question. If a large herd of swine is inoculated with cultivated swine plague schizophytæ, cultivated, for instance, in milk, it may be expected that móst of the animals will take the disease in a mild form, and that the direct losses by death will be very few: but on the other hand it is also possible that such a simultaneous outbreak of swine plague in a whole herd, as would result from such a wholesale inoculation, no matter how mild the cases originally may be, will cause a considerable accumulation of the infectious principle (the swine-plague schizophytæ, and their germs) within the herd and on the premises; and such being the case, it may be expected that many animals, while affected, will get a sufficient influx of the swine plague schizophytæ, with their food, their water for drinking, and sores or wounds that may happen to exist, to make their case a protracted and malignant, or even fatal one. Further, experience teaches that nearly every pig that recovers from an attack of the plague, even if the same is very mild, and only the result of an inoculation with cultivated material, will become a runt or be stunted in its growth, and will never pay its owner a full price for the food it consumes. The lymphatic glands, or at least a great many of them, it seems, undergo more or less permanent changes, which disqualify them to perform their functions as fully as those of a perfectly healthy animal, and this alone is sufficient to account for the disordered nutrition, even if the morbid changes, invariably produced in the lungs, are comparatively unimportant.

6. SWINE PLAGUE IN OTHER ANIMALS.

By last year's investigation (*cf.* special report No. 22) it was found that swine plague can, under favorable circumstances, be communicated to other mammals. Two years ago (*cf.* special report No. 12) I tried to infect chickens with the disease by feeding them with morbid tissues of a dead pig, but did not succeed. Last summer I repeated the same experiment on a larger scale, and repeatedly fed large quantities of very infectious morbid tissues, such as lungs, liver, heart, lymphatic glands, intestines, blood, pieces of meat, &c., to quite a number of chickens; besides this the chickens consumed considerable corn refused and made dirty by the experimental pigs, but not one of them contracted the disease or exhibited any symptom of disease resembling swine plague. So it may be safely concluded that chickens possess very little, if any, predisposition to the disease, and are not likely to become infected; further, that the latter and so-called chicken cholera are entirely different diseases, which have no causal connection whatever to each other.

7. THE INFECTIOUS PRINCIPLE.

To determine the true nature, and to learn as much as possible about the characteristics and peculiarities of the infectious principle, the swine-plague schizophytæ has been one of my principal endeavors, because any advance gained in that direction I considered as of the greatest importance, not only to science, but also for practical purposes. If we want to fight and to conquer an enemy, we must first know the same; consequently, if we want to fight swine plague we must know as much as possible about its nature and cause. I have, therefore, endeavored to procure the best objectives obtainable. Those principally used are a $\frac{1}{10}$ homogeneous immersion of Tolles, and a $\frac{1}{15}$ also homogeneous immersion, made a month ago specially for my work by the same renowned maker.

As to a proper generic name of the swine-plague schizophytæ, I am at at loss. The principal authorities on such low forms of life, Cohn, Klebs, and others, who have attempted a classification, do not agree as to where the generic lines ought to be drawn. At any rate, the schizophytæ of swine plague do not fit into any of the genera proposed. They are not bacteria, because the single cells are round; they can hardly be considered as micrococci, because in their developed form they are bispherical; and they cannot be classed among the bacilli, on account of their forming zoöglœa masses. I have, therefore, preferred to use that name which, without any serious contradiction, is given to the whole family, viz: schizophytæ, or the older but less appropriate name, introduced by Naegeli, schizomycetes.

As further proof that the swine-plague schizophytæ and nothing else constitute the infectious principle of swine plague, I can offer the following:

1. Inoculations with swine-plague schizophytæ cultivated in water and in fresh milk (*cf.* account of experimental pigs Nos. 2 A and 2 B), though productive only of a mild attack, proved to be effective, and feeding swine-plague schizophytæ cultivated in albumen to a healthy pig produced in due time a comparatively severe attack of swine plague (*cf.* account of experimental pig No. 7).

2. Open sores, wounds, and scratches attract and absorb the infectious principle if floating in the air (*cf.* account of experimental pig No. 7, and of Mr. Beaty's herd, visited in November).

3. Certain antiseptics or medicines which possess the property of being either directly poisonous to low forms of organic life (schizophytæ), or destructive to those conditions which are necessary to the existence, growth, and development of those minute forms, and among them particularly carbolic acid, iodine, hyposulphite of soda, benzoate of soda, &c., have proved almost sure preventives. As the chemical properties and affinities of those antiseptics are very dissimilar and entirely different, but as they all possess properties which are inimical and more or less destructive to the growth and development of schizophytæ (micrococci, bacteria, and bacilli), it cannot very well be claimed that those antiseptics have proved to be efficient preventives, because the same have decomposed or neutralized a chemical virus and not poisoned or prevented from developing something endowed with vitality and power of propagation.

4. The condition of the blood which, with the exception of containing schizophytæ mostly in shape of micrococci, is never essentially changed or presents anything abnormal until the morbid changes in the affected parts or tissues have become very extensive, and by interfering with the processes of nuitrition and respiration have produced an abnormal composition of the blood. Consequently it cannot be a chemical virus or mysterious chemical something, which one would suppose would first act upon the blood. Further, the morbid changes in the lungs, in the skin, and in other parts, if closely examined, will show that they are the results primarily, at least, of obstructions in the capillaries, and as nothing else capable of causing obstruction in the capillaries has been found than the schizophytæ and their zoöglœa masses, it cannot be presumed that the latter, but something that is invisible, absent, or spirit-like, and never yet shown, has caused the mischief and brought about the obstructions. Besides, the zoöglœa masses or coccoglia are never absent in the affected tissues.

5. The opponents of the so-called "germ theory" of diseases, well knowing that a complete separation of the schizophytæ (micrococci, bacteria, or bacilli, as the case may be) from the animal tissues and fluids is impossible, demand absolute proof, without offering any evidence whatever in support of their own "theories," or even demonstrating the existence of anything akin to what they claim constitutes the cause and infectious principle of infectious diseases. If conclusions may be drawn from an analogy between infectious diseases of plants and animals, Prof. T. J. Burrill, of the Illinois Industrial University, Champaign, Ill., being more favored by the nature of the objects of his investigations—apple-trees, pear trees, &c.—has furnished almost absolute proof in support of the so called "germ theory," when he found and proved that the so-called "blight" of apple and pear trees and the so-called "yellows" of peaches are caused and spread by schizophytæ somewhat similar in size and superficial appearance, but not identical, to those schizophytæ which produce swine plague (*cf.* the transactions of the meeting of the American Association for the Advancement of Science in Boston, 1880).

6. If the infectious principle were a chemical something—a chemical poison or virus—one would suppose that its action would be the same under all circumstances, and that the malignancy of the disease and the time required for its development (the so-called period of incubation) would not be subject to changes dependent upon the season of the year and upon other partially unknown external influences, but such is the case. In the same localities, in the same yards and pig-pens, and in the same breeds of swine in which the disease was exceedingly malignant in 1878, it was, as a rule, very mild in the latter part of 1879 and 1880, while at other places where it did not exist in 1878 it was rather more malignant in 1880. As what has just been stated are undisputable facts, nothing but what is able to grow and develop is subject to changes and acquires vigor and propagates rapidly under favorable and is weakened and multiplied slowly under unfavorable circumstances—in other words, nothing but what is endowed with life—can constitute the cause and the infectious principle of the disease.

7. If the cause and infectious principle of the plague consisted in some chemical poison, the fact that the first attack, if not fatal, produces, as a rule, immunity from subsequent infection, and that some animals possess more predisposition than others, or that an animal while continually under the influence of the infectious principle can recover, can never be explained; but the whole case presents an entirely different aspect, and admits of explanation, if low forms of organic life (schizophytæ) constitute the cause and the infectious principle, forms which, by developing and multiplying, finally destroy the conditions necessary to their own existence in the animal body (*cf.* an article entitled "The Destruction of Germs" in the Popular Science Monthly, communicated in extract in R. Hitchcock's Monthly Microscopical Journal for November, 1880).

Finally, with very superior objectives and a fair ability to handle the microscope and to prepare objects for examination, I have never been able to find any schizophytæ in the blood and tissues of other healthy animals identical to those of swine plague. In my last drawings, those in which the swine-plague schizophytæ are represented, as seen with the $\frac{1}{15}$ homogeneous immersion objective of Tolles, and the Beck No. 2 eye-piece—amplification a little over 1,500 diameters—the difference between the same and other bacteria will be apparent at the first glance. If lower powers, objectives of less superior and accurate construction and of lower angle of aperture, are used, those differences, I admit, can be seen only with difficulty or not at all.

The swine-plague schizophytæ present themselves in different shape and form. The simplest form, it seems, is that of a micrococcus, a small, round body (globule), which strongly refracts the light, of about 0.7^{mm} to 0.8^{mm} in diameter. It occurs in the blood and the morbid exudations in the tissues, &c., of the diseased swine, and is never absent, but is found in some cases and under some conditions in much larger numbers than in others. The second form is bispherical—the globular cell (micrococcus) has duplicated itself. The globular or spherical cell, or micrococcus, grows and becomes somewhat oval in shape, but becomes indented or contracted in the middle, and keeps on growing while the indentation becomes deeper, till its length is about twice its width and its shape bispherical. For some time, however, the bilateral indention does not effect a complete separation, a connection between the two spherical cells remains, sometimes only for a short time, and sometimes longer—may be, for hours. These bispherical schizophytæ are always more or less numerous, are either at rest or moving, and usually provided at one end with a flagellum, a post-flagellum, which, however, is so exceedingly fine that I have never seen it except with the $\frac{1}{16}$ homogeneous immersion objective of Tolles, and an amplification of over 1,500 diameters, and then only while the schizophytæ was moving (*cf.* drawings). These double micrococci, or bispherical schizophytæ, soon multiply under favorable conditions. The bilateral indentation becomes deeper, while at the same time the single cells commence to grow and assume a somewhat oval shape, and in both another bilateral indentation becomes visible. Meanwhile the separation in the middle becomes more perfect, and soon one bispherical cell has developed into two bispherical cells or micrococci, which are yet slightly connected, at any rate they remain together, although the separation appears to be perfect, as each cell presents its own outlines. The division thus goes on, and it often happens (see drawings) that a whole chain of such bispherical schizophytæ adhering endways to each other, comes into the field. If powers of 900 or 1,000 diameters are used, such a chain very often appears like a thin, moniliform bacterium. Under higher powers the appearance is not dissimilar to that of a piece of a chain out of a watch. Sometimes the dividing process is a rapid one, and I have repeatedly observed that the number of bispherical schizophytæ contained in such a chain doubled in less than five minutes.

Thus it will be seen that the propagation is a rapid one. If circumstances are favorable, and especially if the temperature is not too low, these chains break up into smaller ones, consisting each of one, two, or more bispherical micrococci or schizophytæ, which, in separating from their neighbors, spin or draw out a very slender thread—a flagellum or a cilia. But before all these changes and this multiplying by fission take place the spherical and bispherical micrococci or schizophytæ—the bispherical, probably such as have developed from the spherical micrococci, and do not owe their existence to the fission process—form those clusters (zoöglœa masses or coccoglia), which obstruct the capillaries, and, according to my observations, constitute the immediate cause of the morbid process of swine plague. In these zoöglœa masses the spherical or single micrococci, and the bispherical schizophytæ are imbedded in and held together by a viscous substance, the glia, and the spherical or single micrococci undergo their first change, and develop into bispherical bodies, till the glia breaks or opens, when a great many bispherical schizophytæ, and also some of the spherical bodies become free. The former, thus freed, very soon commence to multiply by fission, but as this process results in a production of bispherical, and not of spherical cells or micrococci, the latter must have another origin. In swine-plague material, for instance, in the blood and in the exudation from the lungs, if a day or two old, and sometimes while yet fresh, bacteria of a peculiar shape can be observed. They are rod-shaped, about as long, or perhaps a little longer than two bispherical schizophytæ connected endwise, but not moniliform, and have on one end, or in some cases toward the middle, a bright and light-refracting globule of fully as much, or a trifle more, diameter than the width of the bacterium, and surrounded by a substance, as a thin envelope, which apparently is of less density because less light-refracting. If this globule is situated at one end the bacterium presents the appearance of a short stick with a knot at one end (*cf.* drawing No. 5). Billroth calls this form a helobacterium and the globule a lasting spore (*Dauerspore*). This lasting spore, according to Billroth and Cohn, resists almost any degree of heat and cold, is very prolific, and produces a large number of germs, which develop into micrococci. As such helobacteria are sometimes found in swine-plague material (blood, exudations, &c.), while yet fresh, and almost always when a few days old, it appears probable that the same constitute another form of the swine-plague schizophytæ, develop from a bispherical cell produced by the fission process, and constitute the source of the spherical micrococci. I say it appears probable because I have seen the same cycle of changes complete itself in somewhat larger schizophytæ, belonging to the genus Bacillus and found in the blood of cattle which had died of Texas fever, but so far have not succeeded in watching and observing every one of those changes in the swine-plague schizophytæ, because the exceedingly small size of the latter requires for accurate observation a higher amplification than I was able to apply without loss of definition before I received, about a month ago, the new $\frac{1}{18}$ objective of Tolles.

If these helobacteria, which occur in the blood, exudation, &c., of pigs affected with swine plague, constitute a form of swine-plague schizophytæ, and are the lasting spores of the latter, as is very probably the case, their extraordinary tenacity of life, or great resistibility against adverse influences, probably explains the ability of the infectious principle of swine plague to remain effective for a whole year, if protected by adhering to, or by being imbedded in, a moist and porous substance, such as an old strawstack or other porous body of a similar character. Whether or not the swine-plague schizophytæ are able to multiply by any other means, or in any other manner than stated, I have not been able to observe. One observation, repeatedly made before, has found new confirmation, viz:

Wherever, or as soon, as *bacterium termo* makes its appearance, the swine-plague schizophytæ commence to disappear, and disappear in about the ratio in which the putrefaction bacteria increase in numbers. In blood kept in a vial the swine-plague schizophytæ cannot be found after the blood commences to exhibit a purplish color, or when the blood corpuscles are destroyed. Further, the swine-plague schizophytæ, although presenting the same general characteristics when cultivated in fluids foreign to the animal organism of a hog, show differences in so far as the same develop and multiply less rapidly and with less regularity, and show less uniformity or more difference as to size. It seems the cultivated schizophytæ are slower in their changes, and, therefore, probably less vigorous in producing disease; at any rate an inoculation with cultivated schizophytæ, although effective in producing swine plague, is always followed by a comparatively milder form of that disease than a natural infection or an inoculation with material directly from the body of a diseased hog. This, however, does not prove that every inoculation with cultivated material necessarily produces a milder form of swine plague than any natural infection or direct inoculation, for such is not the case. The difference may be stated thus: A natural infection, or an inoculation with material directly from a diseased animal, as a rule, produces a malignant attack, and as an exception a mild case of swine-plague, the frequency of the exceptions, it seems, depending to a great extent upon the prevailing character of the disease, while an inoculation with cultivated schizophytæ, as a rule, is followed by a mild attack, and as an exception, or in rare cases only, by swine plague in a malignant form.

External influences proceeding from the weather, temperature, and condition of the atmosphere, seem to further, or as the case may be, to retard the development and propagation of the swine-plague schizophytae, and may thus contribute in causing one epizooty to be more malignant than another, and thereby somewhat retard or accelerate its spreading. At any rate the malignancy of the morbid process and the rapidity with which swine plague is spread is by no means the same in different seasons and at different localities. As has already been mentioned, swine-plague was very malignant in Champaign County in 1878, while in 1880 the deaths have been comparatively few, and the spreading has been very slow. Still, the disease has not died out; isolated cases of infected herds can always be found, especially at the borders of the timber; but in many of those herds the disease exists in such a mild form and causes so few deaths that in some cases even the owner, unless he is attentive and looks after his pigs, remains sometimes ignorant of its existence till the death-rate increases. This difference in the malignancy, however, seems to be due to a small extent only to the weather and the condition of the atmosphere, &c., because other influences, proceeding from the peculiarities of the locality, and especially the degree of predisposition possessed by the individual animals contribute considerably. As has been observed before, the offspring or immediate descendants of swine previously affected with the plague and which had recovered before the offspring was born, seem to possess less predisposition than the parent.

Still, the following facts which can be observed everywhere have probably more influence upon the malignancy of the morbid process, and upon the rapidity with which swine plague is spreading, than all other causes and influences combined.

It is always found that the more general the prevalence of swine plague the more violent the individual attacks, and the more malignant the latter the more rapid is the spreading of the disease. If the plague is compelled to subside for want of material, because nearly every pig has died, it will lack a good start when, after some time, the number of swine has increased. Its prevalence must first become extensive before it can regain its old malignancy, and as long as the latter has not been obtained the spreading will be comparatively slow. Cases with intestinal lesions (ulcerous tumors in the cæcum and colon) must become numerous before the epizooty will get a good start. The severe winter of 1878–'79, the continued snow, and the scarcity of swine toward spring—nearly all the swine had died or been butchered—came near stamping out swine plague in all those parts of this State in which it was extensively prevailing in the fall of 1878, and till now it has not been able to get its old foothold, but is making very good progress in some parts of the State, and unless we get a hard winter it may be as bad in 1881 as it was in 1878.

8. THE MORBID PROCESS.

The morbid process, as stated in my former reports, seems to be brought about by the schizophytæ clusters (zoögloea-masses or coccoglia) obstructing the finest capillaries in the affected tissues, and thus interrupting in a large number of the smallest vessels the circulation of the blood. As a necessary consequence, the fluid parts of the blood (serum and fluid fibrin) transude through the walls of the blood-vessels into the tissues, and if those walls are not able to withstand the pressure, and rupture, numerous but small extravasations of blood will take place. That such is the case is very plain in the affected parts of the lungs before perfect hepatization—an organization of the, at first, fluid exudation—has been effected (*cf.* photograph, Plate III, lower part), and also in the skin. Afterwards the exudation becomes organized, that is, a cell-formation takes place, but the newly-formed cells are morbid—different from the cells of which the normal tissue is composed—and show a great tendency to decay or to collapse into detritus; they lack vitality. This process is especially very plain in the ulcerous tumors in the cæcum and colon, and in the sloughs in the skin, but can be observed also in the lungs. The ulcerous tumors, superficially examined, appear to be an excrescence of the mucous membrane of the intestine, but the microscope shows that such is not the case, for not only the mucous, but also the muscular and the serous coats of the intestine, and particularly the connective tissue between them show considerable thickening, and an abundance of neoplastic productions. On the whole, however, the structural arrangement of those membranes is not essentially changed, as long as a decay or collapse of the newly-formed cells into detritus has not taken place, because the morbid process, it seems, consists principally in a deposit of exudation which becomes organized or changed into new but morbid tissue. As soon as the process of decay sets in, and that, it seems, is very soon, at least in the intestines and in the skin, and also at all other places where the morbid surface is exposed, loss of substance can be observed, because the process of decay does not remain limited to the morbid products, but attacks also the original or normal tissue. Whether in the intestines, in the skin, or in a mucous membrane (conjunctiva, and mucous membrane of mouth and nose, &c.), the process is essentially the same (*cf.* microphotographs of sloughs in skin and of ulcerous tumors in cæcum and colon). If an animal recovers, a retrogressive process takes place; the morbid cells melt, and the material is gradually absorbed, provided the original tissue (lung-tissue, for instance), has not undergone essential changes. If it has, the changed or degenerated parts will also be affected by the retrogressive process, melting and absorption. If the structure of the original or normal tissue is not changed, and if no loss of substance is occurring, the affected part or organ may be restored nearly or fully to its normal condition, but where loss of substance occurs, or where the neoplastic process has been extensive, permanent changes remain. In the latter case parts or portions of the original tissue, especially if changed in structure, will melt and be absorbed the same as the morbid products and so more or less loss of substance will take place. Where substance of tissue is lost, three different processes, it seems, can take place. In the lungs, for instance, a partial loss of normal tissue may result in a shrinking of the affected part, or if the loss is not partial, but not very extensive, a cicatrix may be formed the same as in other tissues, in the skin and in the mucous membranes, for instance. An extensive loss of tissue in an ulcerous tumor in the intestines, in which the morbid change extends to all three membranes, and especially if caused by decay into detritus, and not by melting and absorption, seems to be irreparable and fatal. A less extensive loss, involving only the mucous membrane, can be repaired by cicatrization. What other changes are taking place, and of what other processes nature avails herself to restore partial health after a severe attack of swine plague—a restoration to perfect health probably never occurs—I am unable to state; the number of *post-mortem* examinations of animals that recovered are yet too limited.

During my present investigation I have not been able to observe any chemical action, or any directly poisoning effect of the swine schizophytæ upon the animal organism, that can be at all compared with the virulent properties of certain schizophytæ of the genus *bacillus, bacillus anthracis* for instance, which effects a decomposition of the blood in the living animal. The blood of animals, affected with swine plague, of course, undergoes changes in its composition, and diminishes in quantity as soon as the morbid changes become important and extensive enough to interfere seriously with the process of respiration and nutrition, because material is constantly wasted and the supply with new material is very insufficient; but a decomposition or fermentation does not take place, at least not as long as the animal is alive, and cannot be observed in the fresh blood immediately after death. The blood corpuscles, if examined under the microscope, show very often, but not always, a crenated appearance, but healthy blood frequently does the same. The white blood corpuscles, on the whole, seem to be more numerous in swine-plague blood than in healthy blood, but are never numerous enough, unless the animal has been sick for a long time, and is very much emaciated, to justify one to consider their increase as an important and characteristic feature of the disease. The color of the blood is usually dark and appears carbonized wherever the affection of the lungs is extensive, but is of a normal red if the morbid changes in the lungs are limited, say to less than one-third of the pulmonary tissue; consequently the darker color often met with does not need any explanation, and is simply the result of the lungs being unable to effect sufficient decarbonization. The coagulation of the blood proceeds the same as in the blood of healthy animals, and neither perceptibly faster nor slower; and the quantity of serum contained in the blood is only abnormally increased, or, more correctly, the amount of solid constituents is only abnormally diminished if the morbid changes are extensive, and if the animal has been sick for some time and is considerably emaciated. In animals which die before much emaciation has taken place the blood invariably presents a normal appearance and is of a normal composition, with the exception that it contains swine-plague schizophytæ, mostly in shape of micrococci, and is of a darker color, or carbonized.

9. STAGE OF COLONIZATION.

In my former reports I gave the average time at about six to seven days. This year, however, I have met with more cases than formerly in which what I consider as the extremes have been reached. Pigs Nos. 4, 5, 10, 11, and 12 (in all, five in which the disease had a fatal termination) were taken sick within five days after the inoculation, while pig No. 17 had been inoculated nearly fourteen days before it showed plain symptoms of disease. I say "nearly" fourteen days, for it may have shown symptoms a day or two before my visit on November 20, which were overlooked, but when I saw it on that day it evidently had not been sick longer than a day or two. The duration of the stage of colonization (period of incubation), it seems, does not so much depend upon the individuality of the animal—experimental pigs inoculated on the same day with the same material commenced to show symptoms of sickness never more than a day apart, and usually on the same day—as upon the intensity of the infectious principle, or, in other words, upon the number of swine-plague schizophytæ transferred, and upon the stage of development in which the same happen to be when the inoculation is m When pig No. 17 was inoculated the second time, the weather was and the material had been carried over 200 miles in a bottle sea tight. The material used for the inoculation of pigs Nos. 4 an No. 5 showed the shortest stage of colonization, and showed p toms after four days—was obtained in the neighborhood, an for pigs Nos. 10, 11, and 12 was from a malignant case a innumerable schizophytæ. Hence probably its more rapi stage of colonization in the pigs inoculated with cultivated se (pigs Nos. 2 A, and 2 B) was a long one, ten days in both anima sum up, two weeks or fifteen days seem to be the utmost limit, and s or seven days the medium time. The shortest possible time I am not prepared to state; it may be two days or even less, as has been asserted. It seems that the stage of colonization is usually shorter in the summer than in the winter. If in my experiments the stage of colonization has proved to be of longer duration than in those of others, the difference is probably accounted for by the manner in which I inoculated. I inoculated invariably in the external surface of the ear, an organ that carries but little blood and is remote from the heart, and as nearly all my inoculations have been made with a very small inoculation needle, and usually without drawing any blood, only a very small quantity of the infectious principle has been transferred at each inoculation.

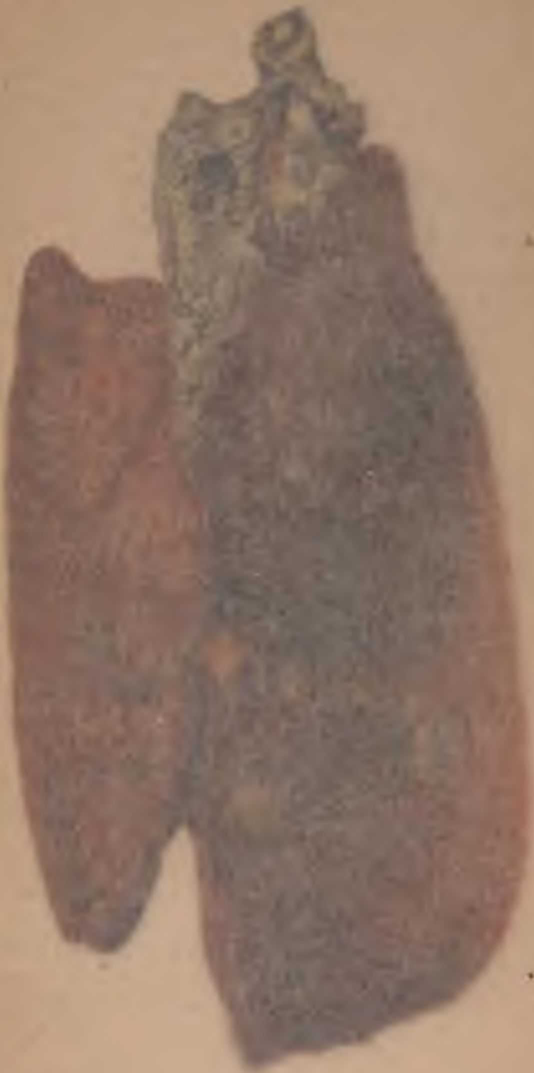
10. MEASURES OF PREVENTION.

To devise effective measures and means of prevention, easy and convenient of application by every one, has been the principal aim and object of my present investigation. Last year certain antiseptics, such as carbolic acid, hyposulphite of soda, and a few others, but the latter not extensively, were used in several large herds with very satisfactory results; for this year it remained to subject the same to a critical test. Last year, when whole herds were treated, it could not be ascertained with certainty whether all the animals treated with the antiseptics, and to all appearances protected and saved by their use, had really become infected or not. That they had was probable, because all had been exposed, but it was not absolutely certain. This year I determined to make the infection a certainty, and inoculated the animals (experimental pigs) to be treated in a manner which had never failed to produce the disease until it failed once in October last in pig No. 17 when inoculated the first time, as has been stated and explained in another place. In all other cases special pains were taken, and neither time nor expense spared to obtain reliable material and to keep it pure at least till the inoculations had been made. Hence, as heretofore an inoculation with swine-plague material (lung-exudation), provided the animal never had an attack before and was left to its fate by not interfering with the action of the infectious principle, has never failed to produce the disease in due time, it must be supposed that at least every *first* inoculation made this year, except that of pig No. 17, would have produced the disease if no medicines had been used. But, as the record of the experi-

Report Commissioner of Agriculture for [illegible]

SWINE PLAGUE

Investigations by Dr. H. J. Detmers. [illegible]



Lungs of experimental Pig No. 4

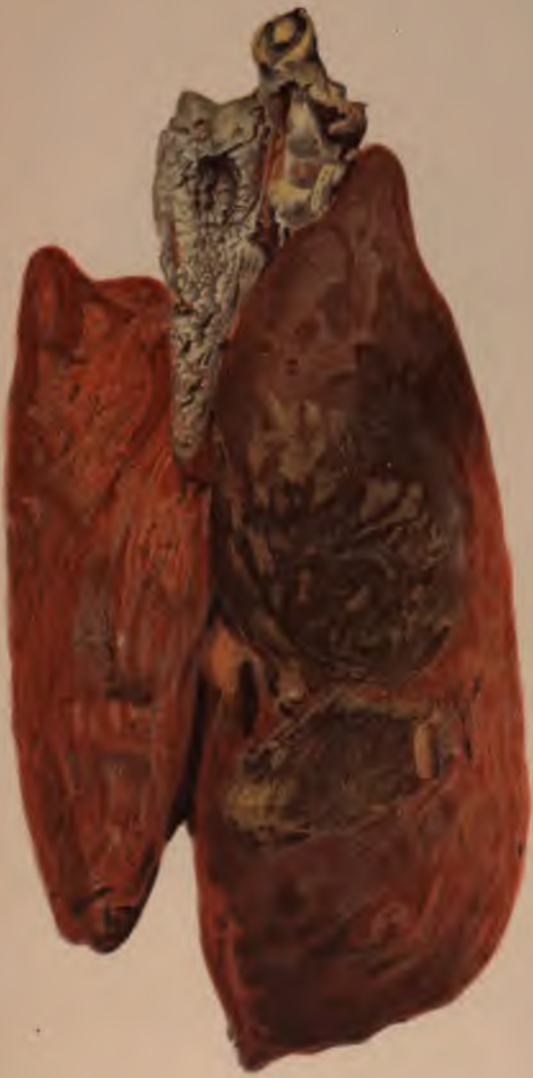
[illegible]

Report Commissioner of Agriculture for 1880.

SWINE PLAGUE.

Investigations by Dr. H. J. Detmers.

Plate I.



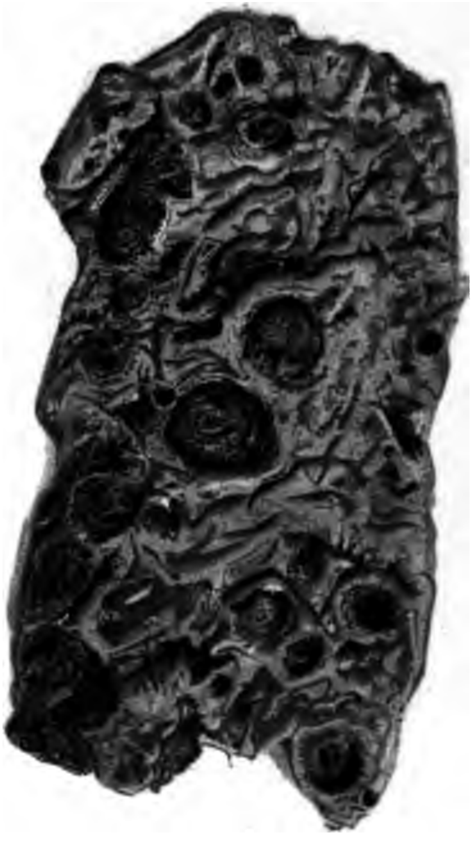
Lungs of Experimental Pig No. 4.

A.Hoen & Co. Lithocaustic, Baltimore.

Report Commissioner of Agriculture for 1880.

SWINE PLAGUE.

Investigations by Dr. H. J. Detmers. **Plate II.**



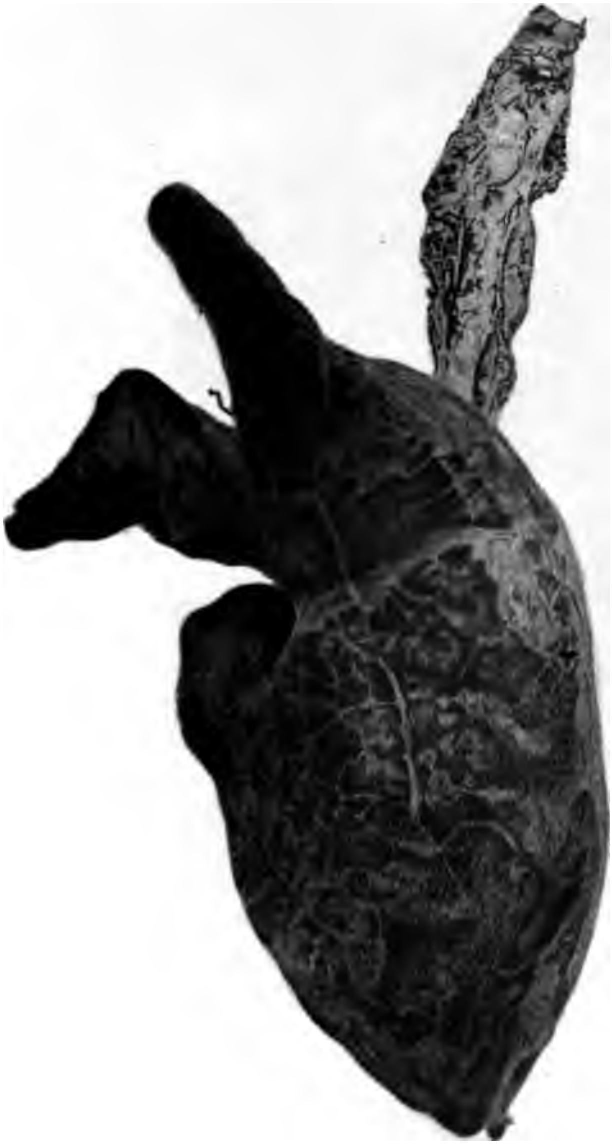
Ulcerous tumors in colon of Mr. Carson's pig.
(Post mortem acc. No. 7.)

A. Hoen & Co. Lithocaustic Baltimore

Report Commissioner of Agriculture for 1880.

SWINE PLAGUE.

Investigations by Dr. H. J. Detmers. Plate III.



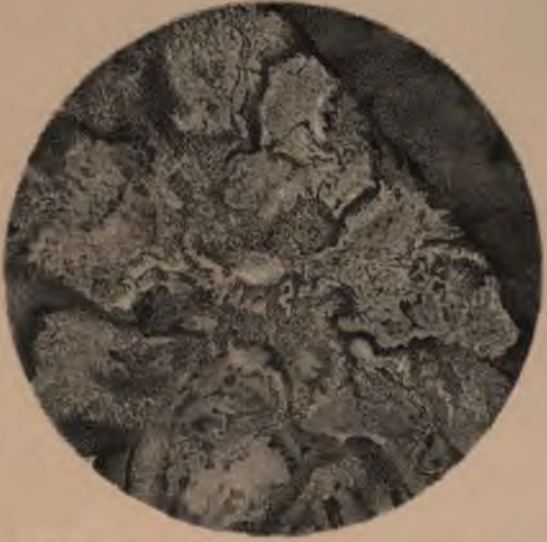
Left lobe of Lung of Mr. Beaty's Pig.

A. Hoen & Co Lithocaustic, Baltimore

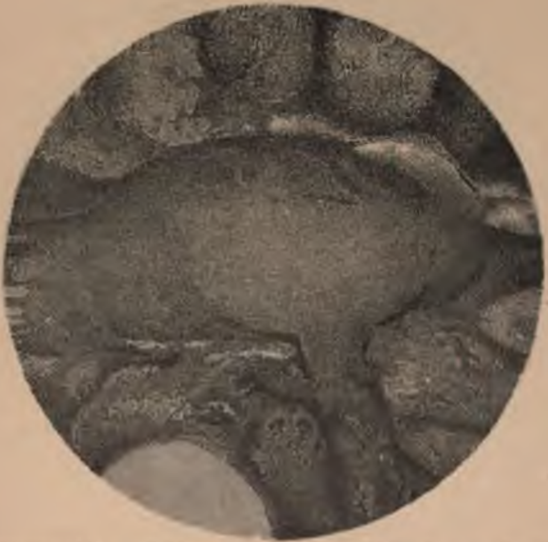
Report Commissioner of Agriculture for 1880.

SWINE PLAGUE.

Investigations by Dr. H. J. Detmers. Plate IV.



N^{o}1^{a} Part of clogged blood vessel and hepatized lung tissue of Lung of Experimental pig No.4. ¼in. objective. x 100.



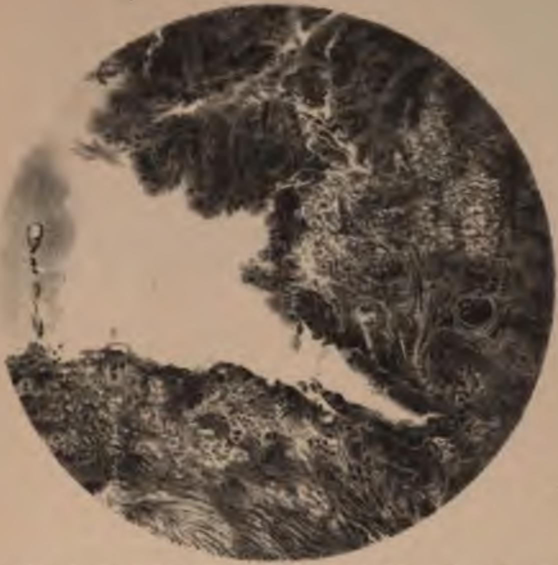
No.1^{b} Extravasation of blood and clogged blood vessel in hepatized Lung of Experimental pig. No.4. ¼in. objective. x 100.

A. Hoen & Co. Lithocaustic, Baltimore.

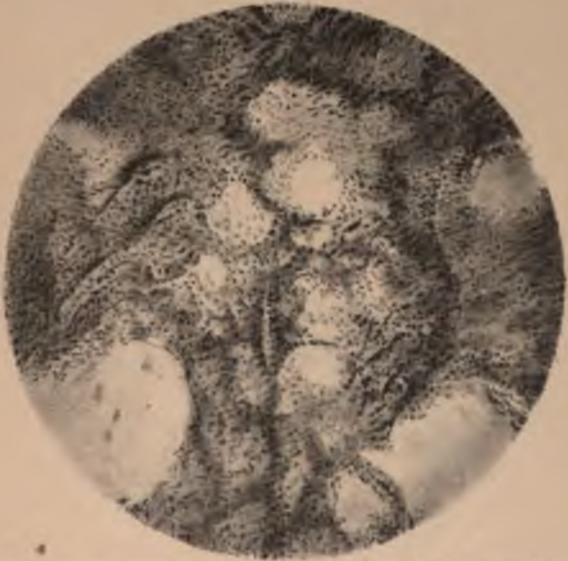
Report Commissioner of Agriculture for 1880.

SWINE PLAGUE.

Investigations by Dr. H. J. Detmers. Plate V.



No. 3 Slough in skin of lip of pig diseased with swine plague.
1 in. Objective. x 22.

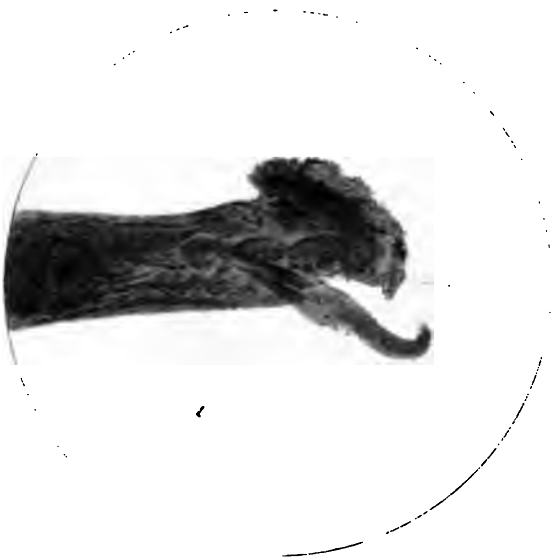


No. 4 Partially diseased lung (incipient hepatization, or exudation unorganized and still fluid) of young pig. ¼ in. objective. x 100.

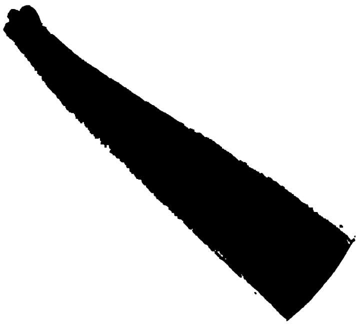
A. Hoen & Co. Lithocaustic, Baltimore.

SWINE PLAGUE.

Investigations by Dr. H. J. Detmers. Plate VI.



No. 5 a Strongylus paradoxus. Tail end of female depositing eggs.
¼ in. objective. x 100.



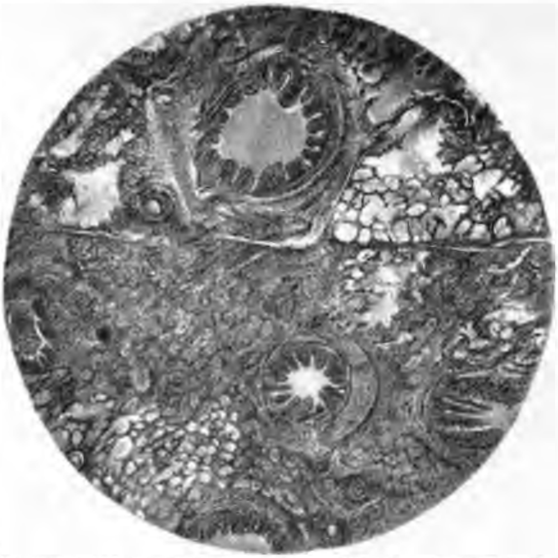
No. 5 b Head of Strongylus paradoxus, or lung worm. ¼ in. Objective. x 100.

A. Hoen & Co. Lithocaustic. Baltimore

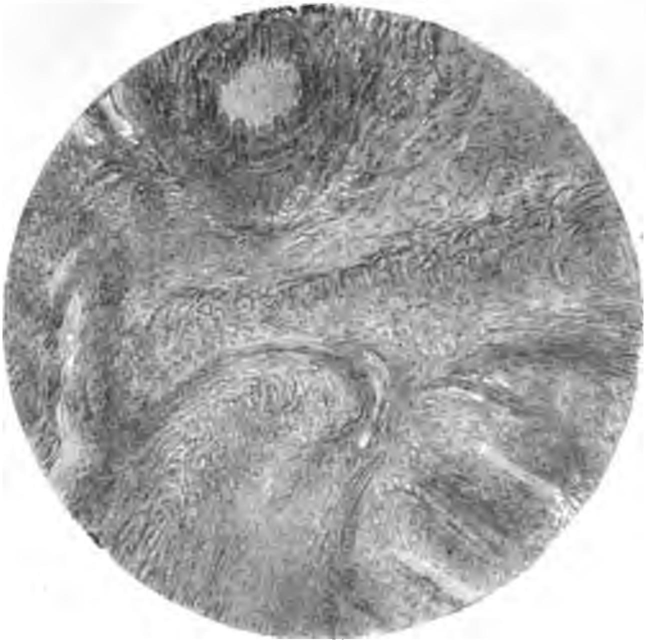
Report Commissioner of Agriculture for 1880.

SWINE PLAGUE.

nvestigations by Dr. H. J. Detmers. **Plate VII.**



No. 6 a Hepatized lung tissue of young pig, showing almost intact bronchial tubes. 1 inch. objective X 22.



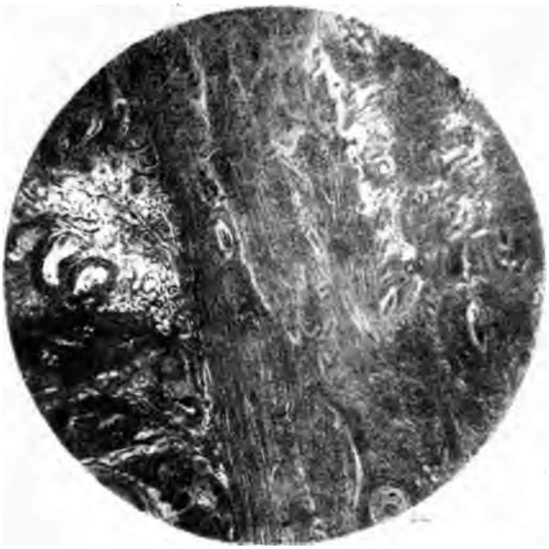
No. 6 b One small and a portion of a larger bronchial tube, both almost normal in perfectly hepatized lung tissue of young pig. A portion of same field as No 6 a but more highly magnified. ¼ in. objective X 100.

A Hoen & Co. Lithocaustic Baltimore

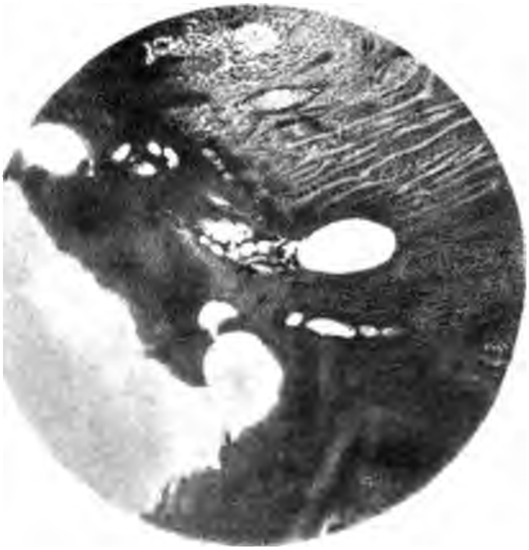
Report Commissioner of Agriculture for 1880.

SWINE PLAGUE.

Investigations by Dr. H. J. Detmers. **Plate VIII.**



No. 7^{a} Portion of diseased skin of Nose of pig. 1 in. objective. x 22.



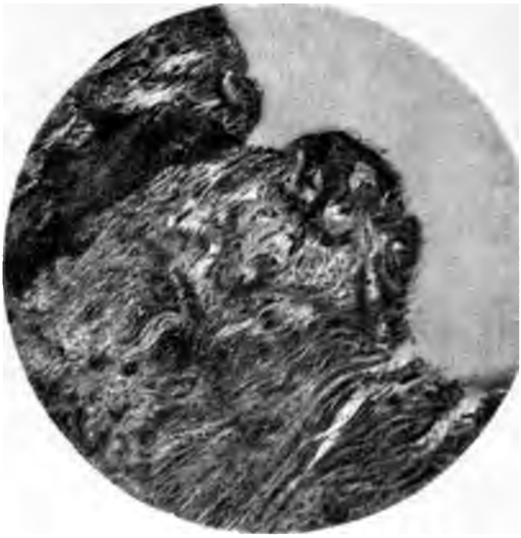
No. 7^{b} Slough in skin of nose of pig. 1 in. objective. x 22.

A Hoen & Co. Lithocaustic Baltimore

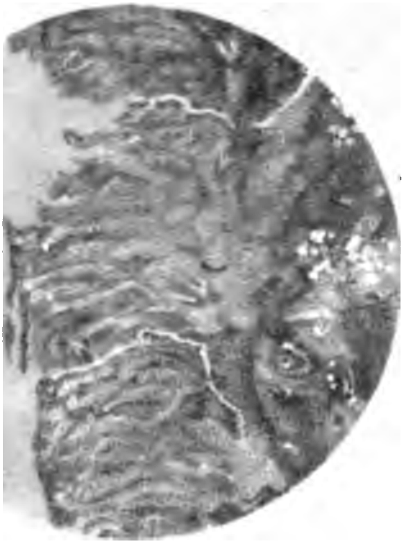
Report Commissioner of Agriculture for 1880.

SWINE PLAGUE.

Investigations by Dr. H. J. Detmers. **Plate IX.**



No. 9a Ulcerous tumor of Caecum. 4 in. objective. x 22.



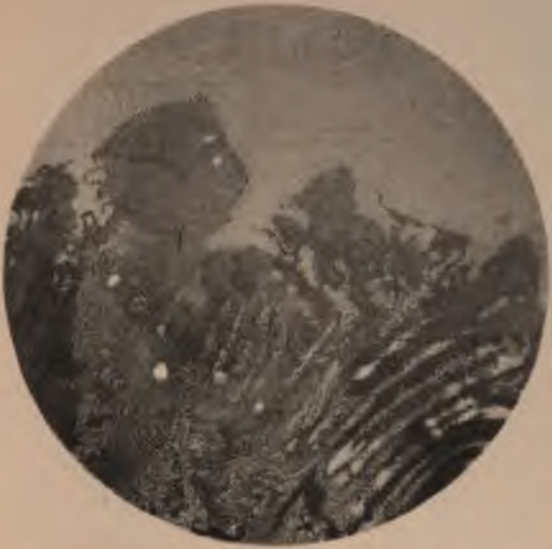
No. 9b Ulcerous tumor of Caecum of J. Martins pig. 1 in. objective. x 100.

A. Hoen & Co. Lith. Caustic. Baltimore

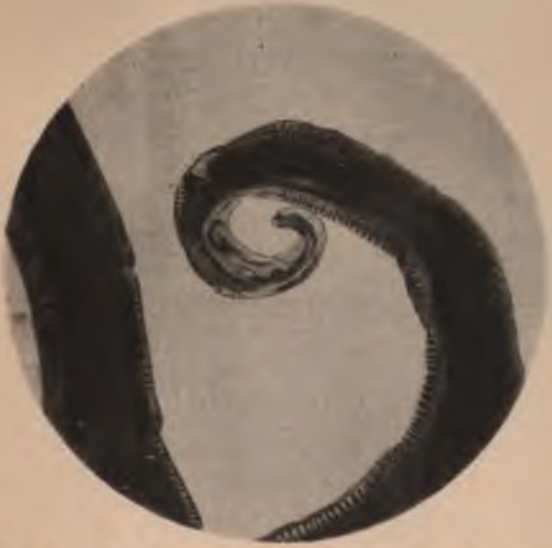
Report Commissioner of Agriculture for 1880.

SWINE PLAGUE.

Investigations by Dr. H. J. Detmers. Plate X.



No. 10. Ulcerous tumor of colon. 1in. objective. x 20.



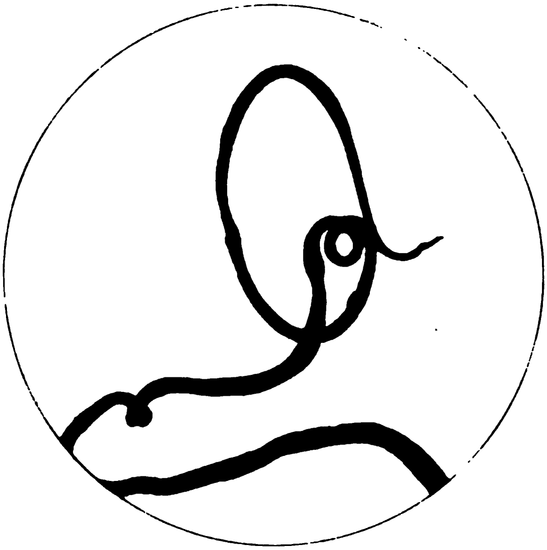
No. 11^{a} Tail of Trichocephalus crenatus. 1in. objective. x 22.

A.Hoen & Co. Lithocaustic, Baltimore

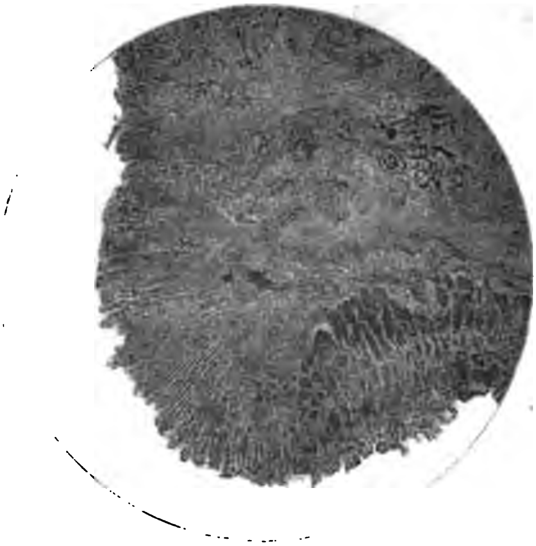
Report Commissioner of Agriculture for 1880.

SWINE PLAGUE.

Investigations by Dr. H. J. Detmers. **Plate XI.**



No. 11b Head of Trichocephalus crenatus. 1 in. objective. x 22.



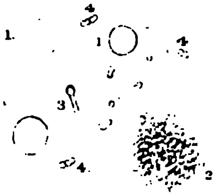
No. 13. Ulcerous colon of small Pig. 1 in. objective. X 22.

A Hoen & Co. Lithocaustic Baltimore

Report Commissioner of Agriculture for 1880.

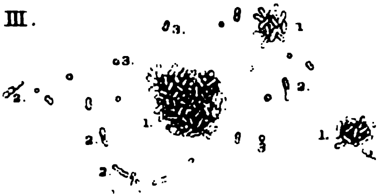
SWINE PLAGUE.

roscopic Investigations by Dr. H.J. Detmers.



rum from the lungs of
No.1.
rpuscles.
-mass.
rium (lasting spore.)
gue Schizophytæ.
Tolle's 1/10 homog. im.
. 80.

III.



Albumen from a hen's egg; charged with infected water April.12th
x 925. Objective: Tolle's 1/10.
Time: 17. 4. 80. 8 P.M. Champaign.Ill.
1. 1. 1. Zoögloea - masses.
2. 2. 2. 2. Rod shaped Schizophytæ of Swine-plague.
3. 3. 3. Swine-plague - micrococci.

Swine-Plague-Schizophytæ as seen in the pulmonal exudation of Experimental Pig No. 5. Some of them more fully developed and all tvely moving Exudation treated with tt. Potash. Examined 26 hours after death; exudation free from any putrifaction and without smell.
x 925. Tolle's 1/10 homogeneous immersion and B Eyepiece.
I. V. 80. 9 P.M.

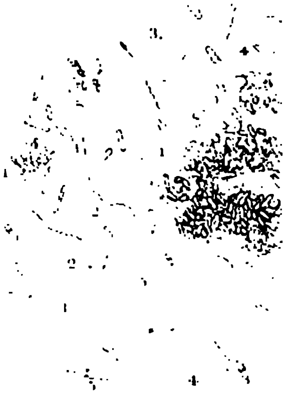
IV b.

The same not treated with caustic potash. a, tumbling, and partially out of focus.

V b.

wine plague Schizophytæ in blood rum of same pig.
1.1. Zoögloea masses.
2.2. Blood corpuscles amplification and same objective as in V a

V a.



Swine plague Schizophytæ in pulmonal exudation of Mr. Philipps's pig.
1 1. Zoogloea masses (part of)
2. 2 Chains of Swine Plague - Schizophytæ.
4 Blood corpuscles
3. 5. 5. Swift moving bacteria just appearing
x 925, Objective. Tolle's 1/10 homog im
Eyepiece Becks No.2 25. 5. 80.

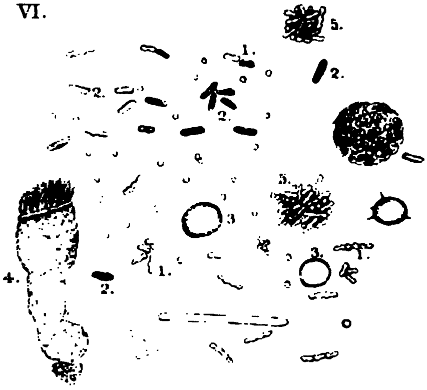
A Hoen & Co Lithocaustic Baltimore

Report Commissioner of Agriculture for 1880.

SWINE PLAGUE.

Microscopic Investigations by Dr. H. J. Detmers.

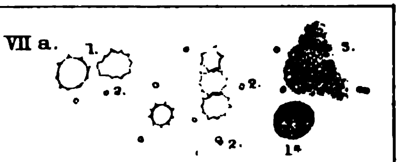
VI.



Pulmonal Exudation of Isaac Martin's pig. x 925. Objective: Tolle's $^{1}/_{10}$ homogeneous immersion; Eyepiece: Beck's B. Time: 19.9.80.

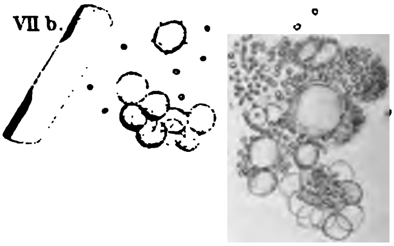
1, 1, 1. Swine plague Schizophytae;
2, 2, 2. Bacterium termo.
3, 3, 3. Blood corpuscles.
4. Ciliated epithelium.
5. Zoögloea mass.

VII a.



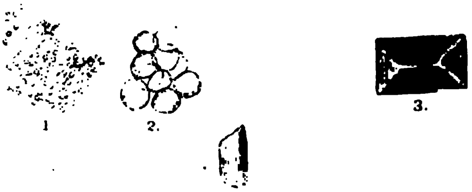
Fresh Pulmonal Exudation of Mr. Munday's pig, killed by bleeding at 9^{30} A.M. 13.10.80.
x 925 Tolle's $^{1}/_{10}$ homog. im. Objective.
Beck's No. 2 Eyepiece.
1, 1. Blood corpuscles.
1^a White Blood corpuscles.
2, 2, 2, Single and double Micrococci.
3, Zoögloea mass 7 P.M. 13.10.80.

VII b.



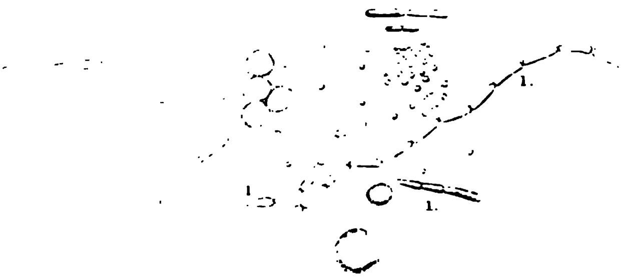
The same as above, but examined in day-light at 11, A.M. 14.10.80.

VII c.



Blood serum from Carotis of Munday's pig.
Examined 11, A.M. 14.10.80. x 925.
1, Zoögloea mass.
2, Blood corpuscles.
3, Crystal.

VIII.



Pulmonal Exudation of Munday's Pig (slightly putrid.)
x 925 Examined at 7^{30} P.M. 14.10.80.
1, 1, 1, Bacillus chains.

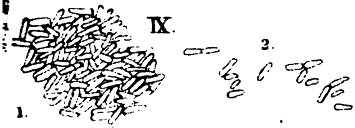
A Hoen & Co Lithocaustr. Baltimore.

Report Commissioner of Agriculture 1880.

SWINE PLAGUE.

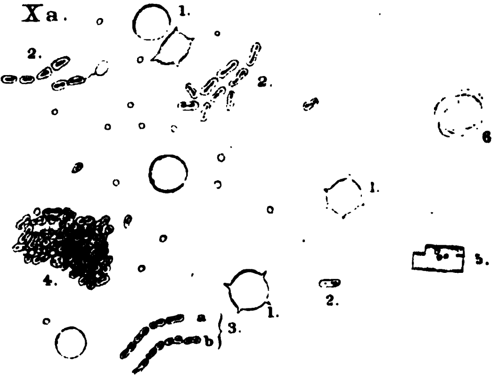
icroscopic Investigations by Dr. H. J. Detmers.

IX.



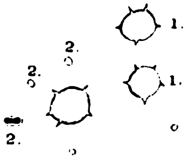
Bacterium termo in Blood serum from carotis (Munday's Pig) very putrid. x925.
Examined at 8 P.M. 14.10.80.
1. Small portion of an extensive Zoögloea-mass, adhering to the cover glass.
2. Specimens of bacteria resting on the slide and moving.
No blood corpuscles.

Xa.



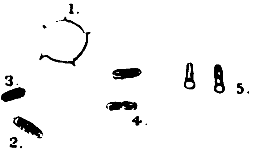
Pulmonal Exudation of Beaty's Pig.
Examined fresh Nov. 7th 3 P.M.
Objective: Tolle's homog. immersion 1/18
Ocular: Beck's No. 2;
Amplification: about 1500.
1, 1, 1, Blood corpuscles.
2, 2, 2, Swine-Plague Schizophytæ.
3 a and b, The same. b, 5 minutes later than a
4, Zoögloea mass.
5, Crystal.
6, White Blood corpuscle.

Xb.



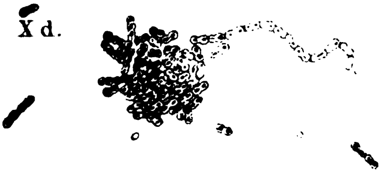
Blood of same animal, examined at the same time with the same appliances and same amplification.
1, 1, Blood corpuscles.
2; 2, 2, Swine-Plague Micrococci.

Xc.



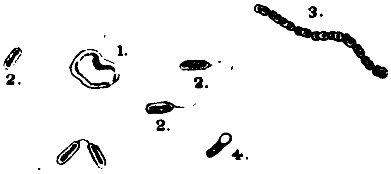
The same Pulmonal Exudation examined with the same Appliances one day later, Nov. 8th at 8 P.M.
1. Blood corpuscle of about 4.4 in diameter.
2, Swinging Bacterium attached to 3 by a slender, almost invisible chord its length is 3.3
4, Just divided Micrococci.
5, Helobacteria.

Xd.



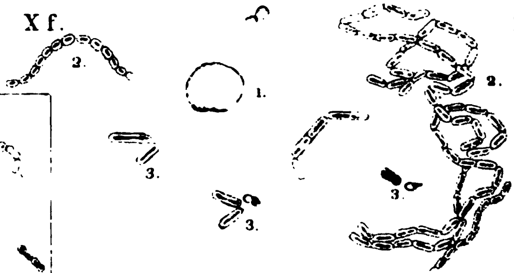
Swine-Plague Schizophytæ in the Lung Exudation of Mr. Beaty's pig. Drawn from Nature. x about 1500.
Objective: Tolle's 1/18 homogeneous immersion. Eyepiece: Beck's No. 2.
Nov. 12th. D.

Xe.



The same Pulmonal Exudation, examined Nov. 13th. Same Objective and same Eyepiece. x about 1500.
1. Blood corpuscle, collapsing.
2, 2, 2, Bacterium termo is making its appearance.
3, A chain of Swine-Plague Schizophytæ.
4, Helobacterium.

Xf.



Blood serum of Mr. Beaty's pig. x about 1500.
Objective: Tolle's 1/18 homogeneous im.
Eyepiece: Beck's No. 2. Time Nov. 14.
1, Blood corpuscle, collapsing.
2, 2, Bacteria-chains.
3, 3, 3, rapitly moving and tumbling. Bacteria.

A. Hoen & Co Lithocaustic, Baltimore

mental pigs shows, none of the pigs treated with antiseptics (carbolic acid, iodine, or benzoate of soda), soon, or immediately after having been inoculated, contracted the disease, and every one of them resisted the effects of subsequent inoculations, No. 9 perhaps excepted, which never fully recovered from its first attack. Some of the pigs, it is true, exhibited symptoms of a very mild reaction, but none of them became diseased, and it is evident that the continued use of the antiseptics prevented the development of the morbid process. While all three antiseptics used (carbolic acid, iodine, and benzoate of soda) proved to be equally effective, carbolic acid, for reasons already stated, deserves preference. It is true a pound of the best crystallized carbolic acid—and I have used no other—is not very cheap, but the small doses required (about 10 drops of a 95 per cent. solution, three times a day, for every hundred pounds of live weight) do not make it an expensive medicine. Thymol, or thymic acid, is probably just as effective, and as the doses required are very small the very high price of that drug might not forbid its use, but not being able to obtain a pure article when I had use for it I did not test its efficiency this year.

According to the results of my experiments and observations, carbolic acid is the preventive which I can most recommend; it proved to be effective in every case, except where its use was not commenced before serious morbid changes had taken place. Still, in the diluted form in which I gave it to the pigs it is not a direct or killing poison to the swine-plague schizophytæ. Its effect in the animal organism seems to be an accumulating one, changing or destroying the conditions necessary to the development and propagation of the schizophytæ, and especially preventing the formation of zoöglœ-masses or coccoglia. Its continued use, say for two or three weeks, seems to place the animal in the same or in a similar condition as that of a pig which has recovered from an attack of swine plague, that is, as far as the infectious principle of that disease is concerned. It probably destroys the conditions necessary to a glia-formation, and, maybe, nothing else. The other antiseptics used seemed to have a similar effect. If no glia (coccoglia or zoöglœ-masses) can be formed, the swine-plague schizophytæ are probably not able to produce any morbid changes, because they are sufficiently small to pass through the whole vascular system—through the finest capillaries—till they reach a part or an organ which can eliminate them again. One thing, however, must not be lost sight of, as it may have contributed a great deal to the favorable results of the treatment with carbolic acid and the other antiseptics. In all my experiments the inoculated animals, while treated with carbolic acid, iodine, or benzoate of soda, were kept by themselves in clean pens, and separated from other diseased animals, at any rate by a board partition; their food was not contaminated with the infectious principle, except once in the case of pig No. 9, as has been stated, and their water for drinking was drawn three times a day from a good well, and therefore always fresh, especially as the troughs were always emptied before any water was poured in. I consider this as important, because if the pigs treated are confined with other diseased pigs, or have to consume food or to drink water repeatedly contaminated with swine-plague schizophytæ, which are constantly discharged with the excretions (dung, urine, &c.) of the diseased pigs, the effect of carbolic acid or of any other antiseptic may not be sufficient to overcome the continued influx, unless the doses are much increased, which probably would be otherwise injurious to the animal. A strict separation of the animals to be protected from those evidently diseased, clean water, and clean food I look upon as very essential to an effective prevention. In making such a separation care must be observed to take the animals to be protected to a place which is, if possible, on higher ground than the lot occupied by the diseased animals, or at any rate on ground which does not receive any drainage or water coming from a place (lot, pen, or pasture) occupied or frequented by diseased swine. Neither must the same contain a straw-stack or anything of a similar character calculated to catch, to harbor, and to protect the swine-plague schizophytæ, and to constitute thus a constant source of infection.

EXPERIMENTS WITH CARBOLIC ACID IN HERDS.

A carbolic-acid treatment for the purpose of prevention has been instituted in several infected herds, and the result, as far as I have been able to learn, has been invariably the same. In no case did any deaths occur among those animals which received regular doses of carbolic acid before they exhibited plain symptoms of swine plague, or before serious morbid changes had been produced. Among the infected herds thus treated I will mention: Mr. Philippi's visited May 24; Mr. William Carson's, visited June 16; Mr. Postlewhaite's, visited June 27; Mr. Lytle's, visited August 23 and September 7, and Mr. Bailey's, visited August 24, August 25, and September 6. Still, as the treatment in those herds had to be left to the owners, and as most of them live a considerable distance from Champaign, I cannot give any detailed accounts and have to rely as to the results of the treatment, &c., on the reports received, except in regard to the two last-named herds, which I visited and examined again. In both the losses had ceased at my last visit.

Inoculations with cultivated schizophytæ as means of prevention.—Having observed in my former investigations that an animal which has once recovered from an attack of swine plague does not easily contract the disease again, and if it does only in a comparatively mild form, and having also observed that an inoculation with cultivated material (swine-plague schizophytæ cultivated in innocent fluids foreign to the organism of a hog) is usually followed by a much milder form of the disease than a natural infection, or an inoculation with material directly from the body of a diseased animal, I thought it worth while to extend my researches in regard to measures of prevention also in that direction. As before stated I inoculated pigs Nos. 2 A and 2 B with cultivated swine-plague schizophytæ, cultivated for the former in milk and for the latter in water (April 14). In about ten days (April 24) both pigs showed symptoms of having become affected, but the attack proved to be a light one (*cf.* account of experiments and their results). Pig No. 7 was fed repeatedly with cultivated material (swine-plague schizophytæ cultivated in the white of fresh eggs, first, second, third, and fourth cultivated generation) and took the disease in a rather more severe form than desirable, but recovered and appeared to be protected against subsequent inoculations, which, at any rate, remained without effect. The animal (*cf.* its record) died afterward from other causes. An inoculation of pig No. 1 A with schizophytæ cultivated in albumen (May 3) remained without effect, probably because the animal had a very slight attack before.

I might have made more experiments in the same direction, but do not consider an inoculation with cultivated, and thereby mitigated, material (swine plague schizophytæ) as easy and practical a means of prevention against losses by swine plague as the carbolic-acid treatment. The latter, at any rate in the hands of the farmer, has several advantages, and can be applied by every one without any difficulty whatever. On the other hand, a cultivation of swine-plague schizophytæ cannot be controlled without the aid of a microscope and the very best objectives, which are expensive and cannot be handled by everybody. Secondly, by adopting inoculations with cultivated material and by using the same extensively as means of prevention, the disease, most assuredly, will be perpetuated the same as pleuro-pneumonia in those countries in which inoculations are resorted to as a measure of protection against that disease, and we never shall get rid of it, although the losses by death may possibly be reduced to very few. Thirdly, an animal that has had an attack of swine plague, no matter how mild, is never again what it was before, because its growth, thrift, and development are more or less impaired by such morbid changes as are left behind.

With the carbolic-acid treatment it is different. In some of the animals that showed a slight reaction a few days after inoculation slight morbid changes may have been produced, but others did not show any visible reaction whatever, and their growth and development did not seem to be injured. Still, the same animals seem to have acquired immunity from the effect of subsequent inoculations or infections. This latter fact has led me to think that it may be possible to produce future immunity, that is, to destroy the conditions necessary to the formation of glia and the development of swine-plague schizophytæ, by treating an animal not inoculated or otherwise infected, for some time, say about three weeks, with regular doses of carbolic acid. At any rate, I intend to experiment in that direction. If it should prove to be the case that a continued treatment with carbolic acid without any preceding inoculation or infection is productive of immunity, even if lasting only a few months and not for life, swine plague may be considered conquered.

As to sweeping and general measures of prevention, I have nothing to add to what has been said in my former reports.

11. TREATMENT.

As to a treatment of swine diseased with swine plague I have but very little to say, except that my observations related in my former reports have found ample confirmation. The morbid process is such that medicines, at least, can have but little effect. They cannot remove the obstructions in the capillaries, and cannot repair the morbid changes. Three diseased pigs, Nos. 11, 12, and 13, were treated with carbolic acid, while No. 10, their mate, received no medicine whatever. Nos. 11 and 12 both died in about the same time as No. 10, and only No. 13 recovered, but was never of any account and succumbed to the first cold spell for lack of vitality or inability to produce in its body sufficient animal heat. Even if a treatment could be devised that would save the life of a diseased hog not much benefit would be derived therefrom, because a pig affected with swine plague is very seldom of any account after it has recovered unless the attack is an exceptionally mild one. Such an animal, as a rule, does not pay for its food and is a source of loss to its owner.

Respectfully submitted.

H. J. DETMERS.

CHICAGO, ILL., *December* 4, 1880.

CONTAGIOUS PLEURO-PNEUMONIA.

Second Report of Charles P. Lyman, F. R. C. V. S.

Hon. WILLIAM G. LE DUC,
Commissioner of Agriculture:

SIR: In my last report to you upon contagious pleuro-pneumonia, I pointed out, as thoroughly as any means for investigation which I then had would enable me to do, the States and counties wherein animals affected with this disease could be found. It was thought at that time, and no investigation since then has been able to show differently, that these counties, or those lying very close to them, contained all the cases that could be found in the United States. Supposing I had succeeded in thus mapping out the whole of our infected district, I began pushing inquiries in a new direction, and for this purpose the following letter was written to one of the most prominent veterinary surgeons and authors in England:

SPRINGFIELD, MASS., *May* 10, 1880.

DEAR SIR: I mail you herewith a copy of my report to the Commissioner of Agriculture on pleuro-pneumonia contagiosa. From it you will be able to see *exactly* to what extent we are infected. The facts to which I especially call your attention are these:

1st. That our ports of Portland, in the State of Maine, and Boston, in the State of Massachusetts, are not in or anywhere near the infected districts; no nearer in fact, I believe, than are some of the free continental ports or provinces to some of the infected ones.

2d. That the cattle coming to those ports for shipment, and indeed for all uses, come entirely from the West—one, two, and even more thousands of miles away from our infected districts.

3d. That the lines of rail over which these cattle are carried going to these ports do not pass through or go anywhere near the infected districts.

4th. That our Western States are free, luckily for us, and always have been, of this scourge.

Now, under these circumstances, is there any method which suggests itself to you by which the Government of Great Britain can be induced to raise the embargo against our cattle coming to her from these free districts, and through these free ports? If you think there is any chance for the matter being arranged the Commissioner of Agriculture will, I think, be very glad to enter into negotiations upon the subject.

Very truly,

C. P. LYMAN.

GEORGE FLEMING, F. R. C. V. S.,
Veterinary Surgeon, Second Life Guards, London, England.

To which, in due time, the following answer was received:

LONDON, *June* 24, 1880.

Dr. CHARLES P. LYMAN:

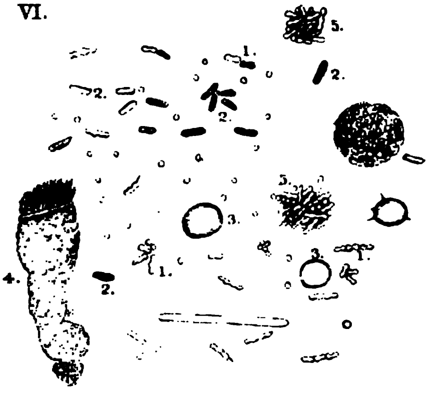
Please excuse my delay in replying to your two letters. I have been away on a tour of army inspection, and only returned yesterday. Very many thanks for your report on contagious pleuro-pneumonia. I very much fear there is not the slightest chance of the embargo on American cattle being raised in this country until the States are entirely free from the malady, notwithstanding the fact you point out that there is an immense extent of country uninfected. So long as only one State, or one portion of a State, is contaminated, so long, depend upon it, will the present law continue. Even the present government, which when not in office, strenuously opposed the law,

Report Commissioner of Agriculture for 1880.

SWINE PLAGUE.

Microscopic Investigations by Dr. H. J. Detmers.

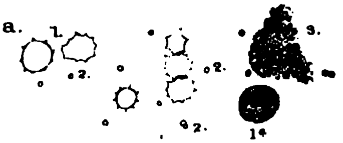
VI.



Pulmonal Exudation of Isaac Martin's pig. x 925. Objective: Tolle's $\frac{1}{10}$ homogeneous immersion; Eyepiece: Beck's B. Time: 19.9.80.

1, 1, 1. Swine-plague Schizophytæ;
2, 2, 2. Bacterium termo.
3, 3, 3. Blood corpuscles.
4. Ciliated epithelium.
5. Zoögloea mass.

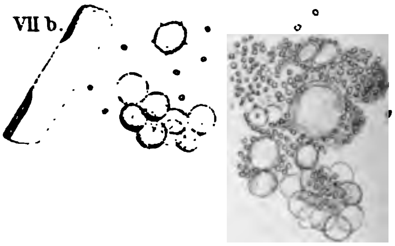
VII a.



Fresh Pulmonal Exudation of Mr. Munday's pig, killed by bleeding at 9^{30} A.M. 13.10.80.
x 925 Tolle's $\frac{1}{10}$ homog. im. Objective. Beck's No. 2 Eyepiece.

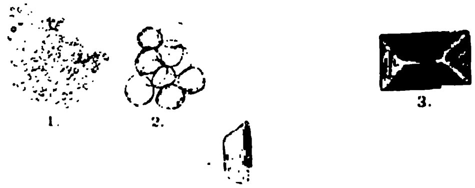
1. 1. Blood corpuscles.
1^a White Blood corpuscles.
2, 2, 2. Single and double Micrococci.
3. Zoögloea mass 7 P.M. 13.10.80.

VII b.



The same as above, but examined in day-light at 11, A.M. 14, 10, 80.

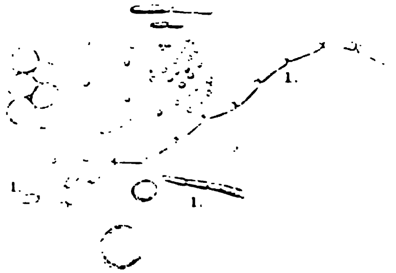
VII c.



Blood serum from Carotis of Munday's pig.
Examined 11, A.M. 14.10.80. x 925.

1. Zoögloea mass.
2. Blood corpuscles.
3. Crystal.

VIII.



Pulmonal Exudation of Munday's Pig (slightly putrid.)
x 925. Examined at 7^{00} P.M. 14.10.80.

1, 1, 1, Bacillus chains.

A Hoen & Co Lithocaustic, Baltimore.

ing found there a few of these numerously reported cases, to trace them back by means of the way-bills, &c., over their course of travel, to their original starting point in the West, or as near to it as possible.

Very respectfully,

CHARLES P. LYMAN.

Hon. WILLIAM G. LE DUC,
Commissioner of Agriculture.

The result of this communication was that, at your direction, on the 23d of June last, I left New York for Liverpool, and arrived there on the 4th day of July; proceeded at once to Edinburgh, Scotland, and called upon Prof. W. Williams, F. R. S. E., and principal of the new veterinary college, who, you will remember, was one of the three experts originally selected to examine the diseased lungs taken from the American cattle which had been landed from the Ontario on January 26, 1879, and the only one of them who positively declared in public that the affection was not contagious pleuro-pneumonia. Professor Williams stated that during the six months succeeding the arrival of the Ontario he had examined portions of the lungs of fully three-fourths of all the animals that had been found diseased, and that he has still not the slightest hesitation in saying that in no case has he found them to exhibit the characteristic lesions of contagious pleuro-pneumonia. He said that Mr. Welsby, a veterinary surgeon living in Derby, near Liverpool, was employed by the steamer people, Messrs. Warren & Co., to examine these animals, in company with Mr. Moore, veterinary surgeon to the privy council and inspector of the port of Liverpool, whose procedure was, as soon as an affected lung was found to make a section of the most diseased portion which was sent up to London for the inspection of the chief of his department. Mr. Welsby would at the same time secure a similar piece and send to Professor Williams; therefore he believed that he had an equal chance with the London authorities for a good examination. He also made several trips to Liverpool and examined the beasts and their lungs while they were being slaughtered. The correspondence with Mr. Welsby was then shown me. A letter of March 16, 1879, accompanied portions of lungs from three different animals, which were condemned by the port inspector as showing the lesions of pleuro-pneumonia contagiosa. These pieces were shown to me and presented simply the lesions of bronchitis with collapse. In a letter of March 17, he writes:

WEST DERBY, *Liverpool, England.*

DEAR MR. WILLIAMS: By the time you receive this the portions of lung I am forwarding will have come to your hand, and which I fear you will declare true cases. Each piece is from a separate animal, and these have arrived per the Ontario, the vessel that brought the cattle you were in Liverpool about a short time since. In examining fifty-five lungs to-day; twelve were found similarly affected (some a little more) to the specimens sent you. I should be glad if you will wire me by 10.30 a. m. to-morrow * * * what your opinion is * * *

In haste, yours faithfully,

J. WELSBY.

These portions of lungs were shown me, and exhibited, as did the others, simply the lesions of bronchitis with collapse. On March 18, he writes: "I have not agreed with the opinion expressed here about any of them, but am doubtful about a piece of the last lot sent you. In London they have *no doubt.*" On March 24: "With regard to the animals when living, I had opportunities of seeing them daily; they appeared well; no cough; breathing and temperature normal, and eating well." On April 21: "No more specimens are wanted in *London.*" On May 19: "Have sent to Professor Walley also specimens from cattle received by steamship Minnesota; he agrees with us in this, but says that it was zymotic pleuro-pneumonia on Ontario." On June 7 he writes: "I am commencing to direct attention to the Canadian cattle instead of Western States. Mr. Moore sent a piece of lung from a Canadian ox to London on Thursday, and informed me it was typical of contagious pleuro-pneumonia, and expected Professor Duguid down, but instead, a telegram came, ordering their release if no further disease was found; two others were then slaughtered, and I was requested to be present; they were perfectly healthy. I was sorry that I could not send you a piece of the lung that went to London, but no doubt shall have an opportunity of doing so before long." Here I was given a piece of lung which certainly showed lesions resembling those of contagious pleuro-pneumonia more than did any other specimen that I saw in the professor's possession; it was said to be from the Canadian case above referred to, but had been in spirits so long that a satisfactory examination could not be made. Professor Williams, however, declared that in his opinion even it was not the disease, but that it looked more like it than did anything else he had seen from our side of the water.

In the new edition of his book on Veterinary Medicine Professor Williams has gone into the matter thoroughly, not only in the text, but by colored lithographic plates, which are said by all who saw the pieces of lung which were sent to Edinburgh to be remarkably like them. In the appendix the whole of this matter will be found reproduced.

I next saw Professor Walley, principal of the Edinburgh Veterinary College, who holds an appointment in Edinburgh under the Veterinary Privy Council, and was one of those who went to Liverpool and examined as an expert the lungs from some of the Ontario cattle. He said: "I was called to Liverpool, and there shown animals together in a building, which I was told came per steamship Ontario from America; a few of them were coughing, I should judge giving the pathognomonic cough of contagious pleuro-pneumonia. I examined them; they gave no elevation of temperature that amounted to anything as a sign; they varied a little; some would be a degree higher than others, but nothing remarkable in any. While this examination was going on, and before we had finished to my entire satisfaction, a man came to say that we were wanted in the slaughter-house, where we went at once, and found two animals, that we were told had been taken hap-hazard from this cargo of the Ontario, hanging partially dressed, and from these I saw lungs taken that exhibited to me, without any doubt, the well-known lesions of contagious pleuro-pneumonia. I was not at the place for more than an hour, and Professor McCall, principal of the Glasgow Veterinary College, was the only veterinarian with me. Mr. Hall, the consignee, or his agent, was there, and said that there was no doubt about this; "that it really was pleuro." In answer to questions, the professor said the animals were in as good a condition as any of the others, *i. e.*, about half fat; that there were several diseased spots in their lungs, and that the largest was about the size of the crown of a Derby hat; that the diseased portions were "marbled," and the parenchyma varied in color from deep red to pink, but it was mostly of a pinkish shade; that there was no attempt towards the formation of a cyst-wall around any of the diseased portions, because the disease had not been of sufficient standing.

Being asked if he did not think it strange that contagious pleuro-pneumonia should exist to so great an extent and the animal be as fat as any of the rest, and still have no elevation of temperature, and no encysted portion of lungs, he answered that he had had no opportunity of examining *these* animals before death as to temperature or anything else, and could give no idea as to how they looked when alive. He regretted that no one had saved a piece of these lungs—it ought to have been done. Since that, which was the only time he had been in Liverpool on this business, he had examined several *pieces* of lungs said to be from American cattle, and they had *not* exhibited to him lesions of contagious pleuro-pneumonia, but of broncho-pneumonia, and the colored plate in Professor Williams's book was a fairly good representation of their appearance, but it did not represent *at all* the appearance of the lungs that he had examined in Liverpool said to be from the Ontario cargo. He was told that these two cattle that he saw in the Liverpool slaughter-house had been drafted at random from the cargo of the Ontario by Mr. Hall.

From Edinburg I proceeded to London and the office of the veterinary department of the Privy Council. In the absence of Professor Brown, the chief of the department, I saw Mr. Cope, the chief inspector, who kindly showed me what specimens they had of "American pleuro." They were few in number and very small in size, and had been in preservative fluid so long that they were very much altered. They were very different from those I had been shown in Edinburg—said to be the same (see Mr. Wellsby's proceedings)—having very much more the appearance of the contagious pleuro-pneumonia, of which the former showed *nothing*. "Animals affected with pleuro-pneumonia," said Mr. Cope, "come to us from the ports of Baltimore, Philadelphia, New York, Boston, and Portland, and we are now (July 12) receiving more than ever of it. You can see it for yourself by going either to Deptford or Liverpool, but Liverpool would be the best place." I was informed by this gentleman that formerly the Privy Council had power to release from the restriction a part of any country that they saw fit, but now it must be a whole country, if any, and that could not be until the whole of that country was absolutely free from disease. Anything else would need the action of Parliament. There is absolutely no option in the matter—the rule or law must govern. (See appendix.) In answer to a question, Mr. Cope said that they had never had a suspicion of Canadian cattle. Subsequently I was fortunate enough to see Professor Brown, veterinarian-in-chief to the department.

I asked him, supposing drafts of cattle were made from our healthy Western districts, transported over lines of rail which were entirely away from our infected districts, in cars used for these and no other cattle, if inspectors could guarantee that they had not been in the same yard, or mixed with any other cattle on the route or at the port of embarkation, and were healthy at time of shipment, and inspection at the port of debarkation should show that cargo after cargo coming under these regulations could be landed free from pleuro-pneumonia, would the embargo be raised in favor of cattle so inspected from such a port? To this Professor Brown answered that even if England were disposed to remove the restrictions from any one port under certain methods of inspection, as he understood it, the United States were not, as matters now stood, able to prevent cattle coming to said port from any point that people chose to send them. I told him that I thought the matter could undoubtedly be arranged with the State authorities and railroad companies so as to be perfectly safe. He intimated that this would be too loose an arrangement to give England much confidence, and further said that he did not know what there was to prevent a diseased or infected animal from being sent at any time from the infected Eastern district directly to the parts in the West from which these drafts were being made. The Government of the United States, as a government, had not as yet shown the slightest interest in the matter, and that, in the absence of any national laws relating to the movements of animals exposed to or infected with contagious diseases, he should not advise any change from their present methods. Here a representation was made setting forth the sovereignty of States and their powers—that a State could make any laws upon the subject that she thought proper, providing it did not conflict with the Constitution of the United States. In answer to this the opinion given was that decidedly, in this matter, these could not take the place of national laws; that it would be highly impracticable for Great Britain to recognize independent State governments while dealing with the United States.

Following is a list, which was kindly furnished me by the veterinary department, giving the cargoes of cattle among which pleuro-pneumonia had been detected, and which had arrived from our ports of Boston and Portland (thought to be free from disease) since January 1, 1880.

Date.	Steamer.	From—	To—	Number of cases of pleuro-pneumonia.
Jan. 11	Milanesian	Boston	London	*12
16	Massachusetts	....do	Liverpool	9
Feb. 4	Palestine	....do	....do	2
7	Bavarian	....do	....do	8
10	Lake Nepigon	Portland	....do	2
12	Brazilian	Boston	....do	10
12	Iowa	....do	....do	16
17	Canopus	....do	....do	1
20	Salerno	....do	Hull	2
21	Bulgarian	....do	Liverpool	3
26	Lake Winnipeg	Portland	....do	1
27	Bohemian	Boston	....do	8
March 4	Massachusetts	....do	....do	7
4	Illyrian	....do	....do	7
20	Palestine	....do	....do	8
24	Iowa	....do	....do	4
27	Egypt	....do (?)	....do	1
30	Glamorgan	....do	....do	8
April 18	Massachusetts	....do	....do	5
30	Iberian	....do	....do	1
May 5	Lake Nepigon	Portland	London	1
19	Bohemian	Boston	Liverpool	4
20	Illyrian	....do	....do	13
June 2	Victoria	....do	....do	4

* Two died.

At Deptford, which is the foreign animals' wharf for London, I at this time saw some twenty-seven hundred head of American bullocks tied up waiting slaughter; they had been received mostly from New York, a few from Baltimore. From the ocean steamers these beasts are landed some distance down the river, and from there reshipped in a transport which brings them directly to the landing-stages for this wharf. This transport boat is thoroughly disinfected after each cargo.

From London I proceeded to Liverpool, arriving there on the 13th of July. Cattle from the United States arriving in this port are allowed to land at three different places, namely, the Huskisson Branch Docks No. 2, on the Liverpool side of the river, at Woodside and Wallasey landing-stages on the Birkenhead side, and at these places only. For their reception, and the accommodation of the trade, under the present restrictions, the dock company have fitted up on the wharves fine buildings to serve as stables for the cattle while alive, also slaughter-houses and cooling rooms.

The law allows the animal to remain alive not longer than fourteen days after debarkation, during which time he must remain in this building, subject to a certain daily charge, payable to the dock company. After each cargo has been disposed of, the whole of the premises are most thoroughly cleaned before being again filled, and if any such contagious malady as foot-and-mouth disease has been found they are thoroughly disinfected, and if thought necessary all the manure and other litter with which they may have been in contact is destroyed, under the direction of the Veterinary Department, but at the expense of the dock company.

With the credentials furnished me from the Privy Council office I called upon the Verterinary Inspector of the port, Mr. J. W. T. Moore, F. R. C. V. S., and requested to be allowed to accompany him for a time in his daily inspections. To this he kindly assented, and during the whole of my stay showed me every attention and rendered me every assistance within his power. His method of inspection is to make an examination of the live animals within as nearly as possible twelve hours after the landing of a cargo. For this purpose the beasts are driven into the stables and tied up facing a passage way. Down this the inspector passes, noticing carefully each beast. If anything unusual is observed in any one case, the animal is made the subject of a minute examination, when, if found particularly diseased, he is either put by himself or slaughtered at once. This examination being completed and the cargo "passed," the owners are at liberty to commence slaughtering as soon as they wish. In the slaughter-house the men have orders not to allow any lung or *portion* of it to be taken away until it has been inspected by Mr. Moore. For the purposes of this lung inspection the product of the whole day's killing is hung up, and once each day every slaughter-house where killing is going on is visited by the inspector, and every lung carefully examined by him. If any one is found which he considers exhibits the lesions of pleuro-pneumonia it is destroyed, and an inquiry made which soon shows beyond a doubt exactly to what cargo the affected animals belonged.

On July 14, 210 bullocks, the cargo of the steamship Carolina from Baltimore, were examined, and four of these were condemned by the inspector as being "suspicious" of pleuro pneumonia. However, upon *post-mortem* examination nothing of the sort was found.

On July 15, the steamship Federico, from Norfolk, Va., landed 128 bullocks and a carcass. A *post-mortem* examination of this carcass showed that the animal had been trampled to death; seven of the ribs were broken. During the lung examination to-day two pairs were found that were condemned as showing the lesions of pleuro-pneumonia. One pair showed plainly and plentifully the peculiar lesions of tuberculosis, and in addition contained several small spots in which the changes supposed to be peculiar to pleuro-pneumonia could be plainly seen, and upon which they were condemned. The history of these animals, so far as it could be procured in Liverpool, was, that Mr. Smith bought of Mr. Roddick 194 bullocks *ex* steamship Brazilian, from Boston, July 7. These were consigned to the seller by J. & C. Coughlin, of London, Canada, but were from the United States; there were two hundred of them; five died on the passage. The inspector here saw the lungs of some of these that were landed dead, and found death to have occurred from causes other than pleuro-pneumonia.

July 16.—A case of pleuro-pneumonia was reported by Mr. Moore as coming on the Iberian from Boston, but the lung lesion was so very small (scarcely as large as a filbert) and its appearance was such that it seemed to me very doubtful if even the semblance of the disease was present.

July 17.—Examined *ex* steamship Malta, from Boston, 397 bullocks.

Five were landed dead, and one was killed on landing. One of the five landed dead was so much decomposed as to prevent a satisfactory examination. The lungs of the other four were emphysematous only.

July 19.—Two lungs from beasts which came on the steamship Victoria, from Boston, were reported as showing pleuro-pneumonia, the largest "spot" being about 1¼ inches in its largest diameter, and situated exactly at the root of the lung, indurated to the touch, and upon being cut into exhibited the usual "marbled" appearance of pleuro-pneumonia, but in the center of the "spot" appeared a small, rounded body not larger than one-fourth inch in diameter, the exact nature of which future microscopic examination will probably determine. This was surrounded by a layer scarcely a line wide of what seemed to the naked eye to be a thin pus of a grayish color; this, in its turn, by a thin membranous wall; this, again, by the "marbled" appearance already referred to, the interlobular effusion and thickening being well marked. The lungs of one of these beasts had one, the other three, of these "spots." These animals were sent by Timothy Coughlin, London, Canada, but were animals from the United States.

July 20.—At Canada docks were examined 222 cattle, *ex* steamship Texas, from Montreal. One of these animals, a fat cow, was breathing rapidly and had a temperature of 104° F. She was killed and the lungs examined, but no indication of pleuro-pneumonia was found. Inspector Moore assured me that he had repeatedly had this done, always with the same result.

July 23.—To-day was found a good specimen of what the port inspector regards as showing the lesions of pleuro-pneumonia in the lung of a beast from the cargo of the Aleppo, from New York. These animals were shipped by Charles Kalm, of New York, and by their look did not seem to be "westerners."

I have thought best to make these few extracts from my diary, as they refer to all the cases that were condemned during my stay, and also as they help to show the manner in which the work is done. I have also prepared a table which will show the number of animals landed in Liverpool from the United States from the 2d of July to the 13th of August, most of which I had the privilege of examining alive and dead during my stay. You will observe that the percentage reported by Mr. Moore as affected with pleuro-pneumonia is very small indeed, there being only six such out of 10,670 animals examined.

The animals coming from Canada are landed at wharves entirely separate from those used for the trade with the United States. The animals coming off ship-board are tied up in houses furnished for the purpose, and after a twelve hours' rest and quarantine are subjected to a not very close inspection by the veterinary officer of the port, when, if no contagious disease is found—and there never has been as yet—they are allowed to go inland on the hoof without any further restriction. In this way they become scattered to such an extent before being slaughtered that it was impossible for me to see the lungs as I did those of our own cattle; and, indeed, no officer gives them *any* examination except in so far as has already been stated.

Table showing number of animals landed in Liverpool from the United States, from June 2 to August 13.

Steamship.	From port of—	Date landed.	Cattle.	Sheep.	Hogs.	Remarks.
Olympus	Boston	July 2	391	......	......	
Saint Albans	New York	July 9	392	239	......	
Palmyra	do	July 13	296	288	......	
Bulgarian	Boston	July 7	434	......	122	
Carolina	Baltimore	July 13	210	......	......	
Iberian	Boston	July 14	434	......	......	1 case condemned as pleuro-pneumonia; 6 very small centers of disease.
Brazilian	do	July 7	569	1,314	......	2 cases condemned as pleuro-pneumonia; centers very small.
Federico	Norfolk	July 14	129	......	......	
Victoria	Boston	July 15	597	......	......	2 cases condemned as pleuro-pneumonia; very small centers.
Cella	New York	July 15	98	306	375	
Malta	Boston	July 16	398	......	......	
Aleppo	New York	July 18	282	719	......	1 case condemned as pleuro-pneumonia, and by far the best lesion found.
Massachusetts	Boston	July 19	519	230	483	11 cases swine fever.
Minnesota	do	July 21	416	860	......	
Palestine	do	July 26	366	815	......	
Bavarian	do	July 25	441	......	......	
Pembroke	do	July 28	204	561	287	7 cases swine fever.
Bohemian	do	July 30	435	......	......	3 cases foot-and-mouth disease in cattle.
Tuscany	Philadelphia	July 30	224	......	......	
Illyrian	Boston	Aug. 1	437	......	......	
Istrian	do	Aug. 5	438	......	......	
Iowa	do	Aug. 5	805	......	207	13 cases resembling splenic apoplexy; 5 cases swine fever.
Enrique	Norfolk	Aug. 6	122	......	......	
Gracia	Baltimore	Aug. 8	130	......	......	
Canopus	Boston	Aug. 9	444	......	......	
Bulgarian	do	Aug. 10	427	......	......	
Brazilian	do	Aug. 13	660	618	363	10 cases sheep-scab.
Sicily	Philadelphia	Aug. 13	282	......	......	

Total number of animals landed:

Cattle		**10,670**
Sheep		**5,960**
Hogs		**2,237**
Number condemned as having pleuro-pneumonia	**cattle**	**6**
Number condemned as having foot-and-mouth disease	**do**	**3**
Number condemned as having scab	**sheep**	**10**
Number condemned as having swine fever	**hogs**	**23**

RÉSUMÉ.

About February 1, 1880, the Department of Agriculture, under the act providing for an inquiry into the contagious diseases of domesticated animals, commenced an investigation, the result of which should declare, if possible, the *exact* extent of territory in which there existed any cattle affected with contagious pleuro-pneumonia, on account of which the Government of Great Britain had placed a restriction upon all cattle coming from the United States.

After due time and a thoroughly-conducted investigation, this territory was defined to be one extending (at that time) from Fairfield County, in Connecticut, over New York City and portions of the State of New York lying just north of it; Brooklyn, Long Island, and parts of the island lying just east of it; Jersey City, and over a considerable portion of the State of New Jersey; Philadelphia, and some of the more southeasterly counties of Pennsylvania to Baltimore, and over portions of the more northeasterly counties of Maryland. Further than this, in any locality it was impossible to find a case of the disease, although efforts were made in all directions, and especially among the cattle coming from the same parts of the West as did most of the cattle going to Europe.

Reports were constantly being received, however, from England that cattle affected with pleuro-pneumonia were being frequently landed there. A very short investigation on this side demonstrated clearly that these animals came directly, in nearly all cases, from the West, and oftentimes over lines of rail that were entirely away from any point at which the disease could be located. The next step, therefore, seemed to be to carry the investigation to the other side, to see the diseased cattle as landed there, and, by means of manifests, way-bills, &c., to trace them back to their original starting points in the West, and thus establish the object of the investigation, namely, to find *all* the infected territory.

This was done, and out of nearly eleven thousand beasts landed and examined in Liverpool during parts of July and August, in no one of which could pleuro-pneumonia be detected in the *living* animal, the inspector of the veterinary department of the privy council condemned, after *post-mortem* examination of the lungs, six cases. These six cases have been traced back, and in all except one it has been found that the animals undoubtedly came from the West, and over lines of rail which are entirely north of any localities that are known to be contaminated, the fact being that a part of their journey eastward was generally made through portions of Canada. This of course means that we have this dreaded cattle scourge established among our Western herds; that Chicago, Buffalo, Albany, Boston, or Portland are diseased centers, or else the disease is not pleuro-pneumonia at all.

If pleuro-pneumonia exists in the West, or there are diseased centers in or about the points named through which the cattle pass on their journey eastward, the information now in possession of this department will insure its exact location after a little further time for examination.

In relation to the last phase of the matter, all that can at present be said is, that the particular lungs exhibited present, *in their fresh state* and to the naked eye, ALL the lesions of the contagious disease, but on a VERY SMALL SCALE, and in addition there is another lesion that is *constantly* present in these condemned lungs which has never been described by any authority or noticed by any of our veterinarians to be a constant or even a known accompaniment of the disease in question. What bearing this fact may have upon this part of the question a further and more minute investigation of the subject alone can decide. Professor William Williams, of Edinburgh, a comparative pathologist of world-wide celebrity, asserts that the lungs examined by him previous to my visit did not show the lesions of the disease, but that the changes noticed were caused by bronchitis.*

Whether these cases are or are not due to true contagious pleuro-pneumonia is a matter which does not in the mean time have much bearing upon the question of the removal of the English embargo upon our cattle. While we have pleuro-pneumonia in *any* part of our country, and certainly while we have no national legislation looking in any way towards restricting its spread, and its eventual total suppression, just so long the embargo must and will continue to operate against one of our best commercial interests, and to lay that portion of our agriculturists in the West who are engaged in the raising and feeding of fine beef bullocks under a very severe and unmerited tax, one which, in the estimation of a very good judge of the matter, has reached, during the present year, a sum rising $2,250,000.† What are the actual losses sustained from the presence of the disease, by the farmers and dairymen of the East who are unfortunate enough to be located in the midst of a contaminated center, it is very hard to say; but that the annual losses by death alone can be no very light tax to them is a safe conclusion.

---

* See Appendix. Also conversation with Professor Williams.

† See Special Report No. 22, page 179, Department of Agriculture, for argument in favor of national legislation.

Then, again, while it is still possible to exterminate this ruinous foreign plague, because it is, we most certainly believe, confined to animals that are kept upon fenced farms, should it *once*, by any misfortune, be carried among the great herds that breed, grow, and feed upon the unfenced ranges of the West, its extirpation would become IMPOSSIBLE. The whole Western country, from Texas northward, would become infected; notwithstanding all efforts that *then* might be made to remedy the evil, this great and growing national interest would be perpetually mortgaged, and there would be an almost incalculable annual loss from deaths alone.

The one remedy *now* for all of this is plain, and of comparatively easy accomplishment, viz: Let Congress enact such measures, and authorize such an execution of them, as shall immediately restrict the movements of cattle out from and within infected districts, and in time eradicate every case of lung plague.

SOUTHERN CATTLE FEVER.

This disease,[*] widely known as "the Texas cattle fever," although it has never as yet reached Great Britain, and, therefore, has never been put upon the schedule as one of the contagious diseases coming from the United States, and requiring restriction, is one that, for a short time in each year, causes such immense losses among the animals belonging to Western, Northern, and Eastern cattle growers, dealers, and shippers, that its mention in connection with this report seems to be quite in place.

Beginning, generally, towards the last of July, and extending, with increasing destructiveness, until the time of frost, Western and Northern cattle that have been in contact, in certain ways, with some of the cattle coming from several of the more southerly portions of the country (these seeming perhaps to be in perfect health), contract this fever, which, to them, is much more fatal than it seems to be among the Southern animals, often killing a proportion as high as 90 per cent. of those affected.

A very curious, but still undoubtedly true, feature of the malady is, that these sick Northern animals are not able in any way to communicate the disease to other animals. Its incubation may be from fifteen to forty days. During this period the beast may be shipped from the West, and slaughtered in the East for human food;[†] or it may be placed on board ship and started for the English market, where it is destined seldom, if ever, to arrive, for dying in mid-ocean its carcass is thrown overboard and becomes a total loss to the owner or those insuring its safe arrival.[‡]

---

[*] See report of Dr. D. E. Salmon, page 98, Special Report No. 22, Department of Agriculture.

[†] In 1868, the Metropolitan Board of Health found that the use of meat from animals affected with Southern fever caused an enormous increase in the death-rate by diarrheal diseases, and especially was there developed an utterly obstinate and incurable class of cholaric diarrheas.—Dr. D. E. Salmon, Special Report No. 22, Department of Agriculture, page 117.)

[‡] For additional particulars relating to this fever, see report of Professor Gamgee to the Commissioner of Agriculture, on the diseases of cattle in the United States, 1871; Report of the New York State Cattle Commissioners for 1868, made in connection with the Report of the Metropolitan Board of Health, in relation to the Texas cattle disease, 1869; also, the proceedings and debates of the American Convention of Cattle Commissioners, held at Springfield, Ill., December 1, 2, and 3, 1868. Published at Springfield (Ill.), Journal Printing Office, 1869.

Heavy losses from this cause are also sustained each season by the farmers and dealers in all parts of the North, West, and East; but perhaps the greatest sufferers of all are the breeders and growers of cattle who are so unfortunate as to be located in the States through which the Texans pass on their journey to market, and the States suffering more particularly in this way this past season have undoubtedly been Missouri* and Illinois, although nearly every other State into which the Texans were shipped, from Kansas to Massachusetts, have suffered to a greater or less extent.

How these losses in connection with the foreign trade occur and how they are divided up can readily be seen from the following:†

In June 10,642 animals were shipped to Liverpool; 114 died—loss about 1 per cent.

In July 12,137 animals were shipped to Liverpool; 110 died—loss less than 1 per cent.

In August 9,464 animals were shipped to Liverpool; 272 died—loss over 2 per cent.

In September 10,826 animals were shipped to Liverpool; 619 died—loss over 5 per cent.

This shows a loss in September over June of, say, $67,662.50, which excess of loss is considered by the insurance people to be due entirely to Texas fever, and to verify this we have the following quotations of the rates of insurance:

In August, 1880, the Canadian and English companies charged 2¼ to 2½ per cent. from Montreal. At the same time the rates on American cattle from Boston were from 3 to 6 per cent., the highest rates obtaining against Missouri and Illinois beasts.

During September the Canadian and English rates were 2¾ to 3 per cent. from Montreal. The rates on American cattle during the first half of this same month were 5 to 7 per cent.; during the second half, from 5½ to 10 per cent.; that is, Ohio cattle could be insured at from 5 to 6½ per cent., Missouri from 6½ to 10 per cent. These differences in insurance make a total on a cargo of, say, 300 beasts, of $2,635 against Missouri, $1,312 against Ohio, as the *extreme* Canadian cost of such insurance is but $1,125. This, on the September shipment to Liverpool *alone*, gives a loss of from $45,000 to $85,000, which loss, in the end, comes probably out of the agriculturists.[*]

---

* As tending to show what the feeling among these farmers has been, I copy the following from Professor Gamgee's Report, page 82. It is an extract from a letter of Mr. S. Morgan Welsh, contained in the Prairie Farmer of 26th September, 1868: "Talk," he writes, "to a Missourian about moderation when a drove of Texas cattle is coming, and he will call you a fool, while he coolly loads his gun and joins his neighbors; and they intend no scare either. They mean to kill, do kill, and will keep killing until the drove takes the back track; and the drovers must be careful not to get between their cattle and the citizens, either, unless they are bullet-proof. No doubt this looks a good deal like border-ruffianism to you, but it is the way we keep clear of the Texas fever, and, my word for it, Illinois will have to do the same thing yet. Congress ought to do something in regard to this stock."

In this same connection, but on the other side, I may say that I recently met a gentleman who says that with two others he went South and bought a large drove of Texans and started North with them. They got along very well until a certain point was reached, when they were met by these self-appointed officers of "the shot-gun quarantine," and obliged to turn back, and they were repeatedly obliged to go back and around until most of their cattle had died and their resources used up, when they came North alone, losers of every cent they had invested in the enterprise, which, in the case of my informant, was all that he had in the world.

† I have only had opportunity as yet to personally investigate this one branch of the subject, and that even imperfectly and, as it were, unsystematically, while carrying on the work on contagious pleuro-pneumonia.

Of course these "rates" are based upon the actual results of experience. This being so, the question at once suggests itself, What is the cause for this great *difference* of experience between Boston and Montreal? To this the unqualified answer is that it is due to a properly maintained veterinary inspection carried on systematically under proper laws and upheld by the Canadian Government, while we have nothing of the sort. To substantiate this it will perhaps be well to quote here from a letter recently received from Messrs. Endicott & Macomber, insurance agents, of Boston, Mass., who have this year employed an inspector, and who would accept no "risks" on cattle unless they had been "passed" by this examiner. On October 27, 1880, they write: "We have made this list of ours to include the whole sickly season. It shows a loss of 1¼ per cent., and would show much less had we not taken a small line on Brazilian, which ran into a gale on first day out. The loss on uninspected cattle during the same time has been upward of 6 per cent." When it is remembered that this inspection is only undertaken during the "sickly season," and to prevent the ill results arising from Texas fever alone, the facts are full of significance.

As affecting the breeders of Missouri and Illinois, it may be said that in Boston, October 5, 1880, cattle for shipment were selling at the following prices: Ohio cattle, among which there is considered to be no risk of Texan contamination, 6 cents to 6¼ cents; Illinois steers, 5¾ cents; Missouri steers, 5½ cents. That is, the Missouri farmer, besides having to pay more freight, loses about $15 per head on his steers, and he has to stand not only this severe loss, but in addition, during these months, the constant risk of having his herd contaminated, which invariably results in a heavy death loss.

The absolute remedy for this is plain, and, in view of the facts as related, suggests itself, viz: Let there be enacted proper laws, with a provision for their proper execution by properly-qualified persons, which can be done without injustice to the Southern breeders, and the Western, Northern, and Eastern breeders, traders, and shippers will be protected from this source of danger to the very large commercial interests which they together represent.[†]

---

[*] It is also said to be a fact that while, even at these ruinous rates, the American companies have been losing money the Canadian and English companies have been making something.

[†] In a communication from Messrs. Endicott & Macomber, Boston, dated November 8, 1880, they write: "Inclosed please find report from the Allan line, * * * this shows what inspection will do." The "report," which is printed on a postal card, is as follows:

ALLAN LINE.—The cargo shipments of this line, which have arrived at the port of Liverpool and Glasgow up till this date, this season, took out 10,179 oxen; 18 horses; 11,300 sheep, which were all landed alive and in good order, with the exception of 24 oxen and 159 sheep.

MONTREAL, *October* 19, 1880.

I am perfectly willing and even anxious to give inspection its *full* value, but I honestly think that good management, and good ventilation on boardship, may have had something to do with the splendid results attained by this company. However, what one company can do in this direction, another should be able to approach. I have seen no public statement of this kind made by any other of the steamship companies.

After all, it may be that inspection deserves all the credit these gentlemen have given it, for I find by taking the figures given in Vaughan Brothers' monthly statements of the number of animals shipped to Liverpool and the number dying on the passage, that we have the following results:

In June were shipped from Boston, 5,849; of these 18 died.

FOOT-AND-MOUTH DISEASE

Has been landed in Great Britain in several instances among cargoes of sheep, and once in a cargo of bullocks from the United States.. This is a scheduled contagious disease, and our animals are now under restrictions because of it, which, of course, as long as the contagious pleuro-pneumonia restriction remains, does not really make any difference, and probably any measure that will provide for a *properly conducted* inspection of our cattle previous to shipment will prevent further trouble from this cause.

SHEEP SCAB

Has also been landed from the United States. A proper inspection before shipment will stop this, and thus prevent future trouble.

SWINE FEVER.

Hogs arriving from the United States are restricted on account of this disease. To devise a perfect method for preventing this needs further time and consideration.

Very respectfully,

CHARLES P. LYMAN, F. R. C. V. S.

APPENDIX.

[Extract from annual report of the Veterinary Department of the Privy Council Office of Great Britain 1879.]

The most notable event of the past year in connection with the trade in foreign animals was the removal of the United States of America from the list of countries mentioned in Part IV of the Foreign Animal Orders, owing to the landing at different times during the year of animals affected with pleuro-pneumonia, foot-and-mouth disease, and swine-fever.

My attention was first called to the existence of pleuro-pneumonia among cattle which had been landed at Liverpool from the steamship Dominion from Portland, State of Maine. It is somewhat remarkable that a mistake was made by the policeman who reported the case to the inspector of the local authority in recording the name of the port of shipment as Quebec instead of Portland. The inquiry which was immediately instituted was commenced under the impression that the diseased animals had come from Canada instead of the United States of America.

The circumstances were, shortly, as follows:

On January 14 I received a letter from the Veterinary Inspector of the Local Authority of Liverpool, informing me that he had forwarded for my inspection the lungs of a Canadian bullock (ex-ship Dominion from Quebec).

The bullock had been dressed in the abattoirs at Liverpool, and the Veterinary Inspector's attention had been called to the lungs, one portion of which he found to present appearances "so nearly allied to those of pleuro-pneumonia as to warrant suspicion."

My own conviction at the time was that an examination of the lungs would suffice

---

In June were shipped from Montreal, 3,988; of these 26 died.
In July were shipped from Boston, 5,404; of these 39 died.
In July were shipped from Montreal, 3,985; of these 21 died.
In August were shipped from Boston, 5,488; of these 97 died.
In August were shipped from Montreal, 2,781; of these 3 died.
In September were shipped from Boston, 5,987; of these 181 died.
In September were shipped from Montreal, 4,059; of these 12 died.

It would seem from this that the steamers running from Boston have as good management and ventilation as those from Montreal, on the whole, and that given an equally healthy stock to ship from, that they are as able to show good results. Further, that the ratio of loss increases inexplainably, beginning slightly in July and running through September, unless *some* theory of special cause is accepted.

to show that there was no ground for any suspicion. It was almost impossible that pleuro-pneumonia could have existed in Canada without having been detected, and up to the moment of receiving the letter referred to not a shadow of suspicion had been thrown upon Canadian cattle.

When the lungs were seen, however, it was at once apparent that something more than suspicion was justified. All the unmistakable marks of pleuro-pneumonia were evident, and had the animal from which the lungs had been removed been an English bullock instead of a Canadian animal, as it was then believed to be, no more trouble would have been taken in the matter. But there could be no doubt that the assertion of the existence of the disease in a bullock from Canada would be sternly denied by the Canadian authorities, who would point to the fact that no case of the disease could be found in their country. It was therefore necessary to place the matter beyond all doubt before any action could be taken. Meanwhile the diseased lungs were submitted to the inspection of all the authorities within immediate reach, and all who examined them, including Professors Simonds, Pritchard, and Axe, Messrs. Priestman, Rayment, Holmans, besides the inspectors attached to the department, unhesitatingly stated their opinion that the disease was pleuro-pneumonia. Dr. Yeo, of King's College, who had recently been engaged on behalf of the Agricultural Society in investigating the morbid anatomy of the disease, was next appealed to, not without a lingering hope that he would find on minute examination some microscopic differences between the diseased structures and the similar tissues which he had examined from English animals affected with pleuro-pneumonia, and so relieve me from a difficulty which threatened to assume considerable proportions. Before Dr. Yeo replied the difficulty had been removed by the discovery of the fact that the diseased animal formed part of a cargo from the United States, where pleuro-pneumonia was known to exist. Dr. Yeo, after a careful examination of the lungs which were sent to him, wrote:

"I regard the lung as a beautiful example of the contagious pleuro-pneumonia."

The detection of disease in the cargo brought by the Ontario afforded further evidence of its existence among cattle in the United States

Cargoes of cattle among which pleuro-pneumonia was detected continued to arrive, and, after careful deliberation, the Lords of the Council passed an order, on February 10, to come into force on March 4, the effect of which was to cause the slaughter of cattle from the States at the place of landing in this country.

It was probably to be expected that the importers of animals from the United States would hesitate to accept as final the opinion of the inspectors of the Privy Council when that opinion was quite adverse to their interests. Accordingly, they sought the advice of three gentlemen of undoubted authority in veterinary science, the three principals of the veterinary colleges in Scotland. Two of these experts promptly decided that the disease among the cattle from the Ontario was pleuro-pneumonia; the third formed the opinion that the disease was not pleuro-pneumonia. The matter would not be referred to in this report but for the circumstance that the difference of opinion led to a question being raised in the House of Commons.

On May 12 Mr. Mundella asked the vice-president of the council if he was aware that Prof. W. Williams, of the Edinburg Veterinary College, had written a letter to Dr. Laidlaw, veterinary pathologist, of Albany, N. Y., denying in the most emphatic terms that pleuro-pneumonia had existed in any cattle hitherto imported from the United States; whether his attention had been called to a letter of Professor Williams, dated 29th March, in which the following passage occurred: "Since first arrival of Ontario with cattle, others have arrived at Liverpool, and I have examined the lungs said by Privy-Council inspectors to have pleuro-pneumonia, and satisfied all who have seen them that no pleuro-pneumonia has arrived here from America; indeed, everybody is surprised that such a gross mistake should have been made. The last lot, seven in number, examined by me had bronchitis, with collapse of the lung, but not a trace of pleurisy nor of pneumonia, yet they were declared by the authorities in London to have typical pleuro-pneumonia. I have the specimens most carefully preserved, and am ready to show them to the whole world if necessary"; and what steps he proposed to take to satisfy himself of the correctness of those statements.

Lord George Hamilton replied that a statement of Professor Williams was forwarded to the Privy Council office by the Canadian Government last month, and upon receiving it the Privy Council requested Professor Brown, the head of the Veterinary Department, to investigate the subject. He would read the memorandum which he had drawn up, and which was sent in reply to the Canadian Government:

"On January 26 the steamship Ontario arrived at Liverpool, having on board 195 cattle and two carcasses; 87 head of cattle had been thrown overboard, making the total number shipped 284. On examining one of the carcasses, the inspector at Liverpool found evidence of pleuro-pneumonia, and forwarded portions of the lung to the Veterinary Department. This specimen was found to represent the characteristic indications of the contagious pleuro-pneumonia of cattle so well known in this country. By directions of the Lord President, I immediately instructed Mr. Duguid, one of the inspectors of this department, to proceed to Liverpool and report as to the condition of the animals which had been detained there. Mr. Duguid remained at Liverpool and superintended the slaughter of the cattle, and in the course of the *post-mortem* examination he detected thirteen cases of pleuro-pneumonia in various stages. Since the landing of the cattle from the Ontario, in January, cases of the disease have been detected among cattle from the United States by the inspector at Liverpool in three other cargoes, and in one cargo by the inspector at the foreign cattle-market, Deptford. Portions of the lungs taken from the diseased cattle were forwarded by the inspectors to the Veterinary Department, and I took the opportunity of submitting some of the specimens to the inspection of several experts who have made pleuro-pneumonia of cattle a subject of special inquiry, and they were unanimous in their expression of opinion that the morbid changes were indicative of contagious pleuro-pneumonia. I may add that the alterations which are apparent in the lung structure in contagious pleuro-pneumonia, even in the earliest stages, are so different from those which occur in any other affection of the lungs of the ox that no competent pathologist would experience any difficulty in arriving at a correct conclusion as to the nature of the disease."

In the appendix an account is given of the number of cattle affected with pleuro-pneumonia which were landed in this country from the United States during the year. The number is considerable, and far in excess of the total number of cases of the disease which have been detected among cattle imported in the same period from the continent of Europe. This circumstance ceases to be remarkable when the wide-spread existence of the disease in the States is considered in connection with the fact that the extraordinary development of the cattle-trade with this country has afforded owners of infected herds an opportunity of disposing of the animals expeditiously, and in a manner much more effective than any system of isolation would be.

Further restrictions on imports from America were soon rendered necessary, in consequence of the landing in this country from the States of several cargoes of swine, among which swine-fever was detected. The existence of this disease in America, under the name of hog cholera, was too well known to admit of any discussion, and as diseased animals continued to be landed at Liverpool and Deptford, an Order of Council was passed, on May 8, to come into effect on June 2, placing swine from America in the same position as cattle. It was subsequently found necessary, in consequence of numerous cargoes of diseased swine being sent to this country during May, to bring the Order into operation at an earlier date than that originally fixed.

The slaughter of large numbers of American swine at the port of landing on account of swine-fever afforded an opportunity of obtaining specimens of flesh for examination, with the view to ascertain what proportion of the animals were infected with trichinæ. The inspectors of the Veterinary Department examined 279 separate portions of swines' flesh which were sent from Liverpool, and detected living trichinæ in three specimens.

Portions of trichinized flesh were given to two young pigs, and also to cats and rats, and the mature worm and also the encysted embryos were in this way cultivated. No doubt, therefore, existed as to the dangerous character of American pork, and a consultation on the subject took place with the medical officers of the Local Government Board; the matter was also discussed in the House of Commons, but it was not deemed expedient to prohibit the introduction of American pork into this country, for the reason that such a measure would have damaged the trade without producing any satisfactory results. A large proportion of the objectionable meat would have been sent to this country by a circuitous route, and thus the object of the restriction would have been defeated; besides which trichinosis among swine is known to exist in Germany, and it probably exists in other exporting countries, so that nothing short of total prohibition of swine flesh in all forms from all foreign sources would have been effectual. The possibility of our own swine being to some extent infected with trichinæ has been suggested; the result, however, of many examinations has, up to this time, been negative.

American sheep were the next animals to be brought within the provisions of a special Order of Council. On July 4, the Inspector of the Privy Council at Liverpool reported that he had detected foot-and-mouth disease in a cargo of sheep brought from Boston and landed at Liverpool on July 3.

The Chief Inspector was instructed to proceed to Liverpool and examine the diseased animals, and in the course of his inspection he detected ten cases of the disease in various stages.

An Order of Council was accordingly passed, on November 4, to come into operation on November 21, placing sheep in the same position as cattle and swine from the United States.

No information of the existence of foot-and-mouth disease among animals in the United States of America had been communicated to the Veterinary Department, but it is worthy of remark that in the report of the Minister of Agriculture, at Washington, in answer to a Senate resolution of February 21, 1878, requiring information respecting the prevalence of diseases among swine and other domestic animals in the States, one of the writers describes a disease, which he calls "murrain," in the following terms:

"The disease most prevalent among cattle is murrain. It is characterized by small vesicles in the mouth, on lips, gums, and tongue, with drivelings of saliva, often causing inability to eat or drink. These symptoms are accompanied with fever, swelling of the udder, and lameness."

The writer is not a veterinary surgeon, and he evidently describes in his letter more than one disease under the term murrain; but the above record of symptoms might be copied literally in describing an ordinary case of foot-and-mouth disease in this country.

The Order of Council which provided for the slaughter of American sheep at a foreign-animals' wharf practically completed the exclusion of American animals from Part IV of the foreign animals order. No injury, however, appears to have been done to the trade by this action, and, indeed, so far as the consumer is concerned, it does not appear to be of much consequence whether foreign animals were imported under the provisions of Part II or Part IV of the Order. The object of their introduction into the country is that of adding to the food supply; and experience tends to show that slaughter at the place of landing has not seriously interfered with this object.

In the last report reference was made to the enormous losses which were caused by the hardships of the trans-Atlantic passage, and it is, perhaps, not surprising, considering the extraordinary weather of 1879, that the number of animals lost in transit was considerably larger than in the previous year, as the following analysis of the returns will show:

From Canada there were landed in 1879 at the ports of Bristol, Glasgow, Liverpool, and London 157 cargoes of animals, consisting of 25,185 cattle, 73,913 sheep, 3,663 swine, of which, 154 cattle, 1,623 sheep, and 249 swine were thrown overboard during the voyage; 21 cattle, 226 sheep, and 3 swine were landed dead, and 4 cattle and 61 sheep had to be slaughtered at the place of landing, owing to injuries received in transit.

From the United States there were landed in 1879 at the ports of Bristol, Cardiff, Glasgow, Grimsby, Hartlepool, Hull, Leith, Liverpool, London, Newcastle-upon-Tyne, South Shields, and Southampton 535 cargoes of animals, consisting of 76,117 cattle, 119,350 sheep, and 15,180 swine, of which 3,140 cattle, 5,915 sheep, and 2,943 swine were thrown overboard on the voyage; 221 cattle, 386 sheep, and 392 swine were landed dead; and 93 cattle, 167 sheep, and 130 swine were so much injured that it was necessary to slaughter them at the place of landing.

Thus it appears that 14,024 animals were thrown overboard, 1,249 were landed dead, and 455 were so much injured or exhausted that they were killed at the place of landing; making a total number of 15,728 animals which were either lost on the passage or so much injured that it was necessary to slaughter them immediately on landing.

Notwithstanding the increased restrictions on importations, the number of foreign animals imported was larger in 1879 than in the previous year, the total from all countries out of the United Kingdom being 1,241,847 as against 1,200,323 in 1878. From European countries we received 143,187 cattle, 750,469 sheep, 32,591 swine; from Canada, 25,185 cattle, 79,913 sheep, 3,663 swine; from the United States of America, 76,117 cattle, 119,350 sheep, 15,180 swine; from the Channel Islands, 2,151 cattle only; from other countries, 12 cattle, 22 sheep, 7 swine.

From Ireland we received 641,370 cattle, 673,371 sheep, 429,663 swine.

The total from all sources was 2,986,251 animals in 1879, against 3,043,090 in 1878.

There were landed in Great Britain during 1879, from places out of the United Kingdom, exclusive of the Channel Islands, 2,671 cargoes of animals, consisting of 244,501 cattle, 973,754 sheep, 51,441 swine. In 122 cargoes the inspectors detected disease among the animals on landing in this country. The diseased cargoes came from the following countries: Belgium, 46 cargoes, of which six cargoes, consisting of 3,141 sheep, contained 8 sheep affected with foot-and-mouth disease and 68 sheep affected with sheep-scab. France, 27 cargoes, of which 2 cargoes, consisting of 25 cattle, 30 swine, contained 1 cattle affected with pleuro-pneumonia and 20 swine affected with foot-and-mouth disease. Germany, 496 cargoes, of which 21 cargoes, consisting of 312 cattle, 28,277 sheep, contained 29 sheep affected with foot-and-mouth disease and 496 sheep affected with sheep-scab. The Netherlands, 659 cargoes, of which 21 cargoes, consisting of 1,830 cattle, 11,076 sheep, 1,079 swine, contained 9 cattle affected with pleuro-pneumonia, 1 head of cattle, 7 sheep, and 64 swine affected with foot-and-month disease, and 83 sheep affected with sheep-scab. Canada, 157 cargoes, of which 3 cargoes, consisting of 339 cattle, 1,746 sheep, 180 swine, contained 13 sheep affected with sheep-scab. The United States of America, 535 cargoes, of which 69 cargoes consisting of 13,301 cattle, 8,553 sheep, contained 137 cattle affected with pleuro-pneumonia, 33 sheep affected with foot-and-mouth disease, and 37 sheep affected with sheep-scab.

In addition to the Orders which were in force on January 1, 1879, it was found necessary to pass several Orders in the course of the year, either for the purpose of amending certain provisions in existing Orders or dealing with new conditions.

On the 1st of January, 1879, the new regulations relating to the importation of foreign animals, which had been enacted by the Contagious Diseases' (animals) Act, 1878, and contained in the Foreign Animals' Order (dated the 6th of December, 1878, and numbered 422), came into operation. As stated in the report for the year 1878, the act of 1878 provides that the foreign animals are to be landed only at a foreign-animals' wharf, and are to be there slaughtered, except such animals from such countries as may be from time to time specially prohibited or excepted by order of council. The principal features of the provisions of the Foreign Animals' Order will be treated hereafter under the heading *orders relating to importation*.

Orders relating to importation.—Before noticing the Orders that were issued during 1879 on this subject, it would be well to notice the more salient points of the provisions of the Foreign Animals' Order No. 452, which, as before stated, came into operation on the 1st of January, 1879.

The act of 1878 provided that foreign animals should only be landed in a part of a port, to be called a foreign animals' wharf, out of which wharf they were not to be moved alive, unless the Privy Council by Order absolutely prohibited their being landed, or specially exempted them from the operation of those provisions of the act.

The Foreign Animals' Order, first, prohibited the landing of animals brought from the following countries: The Austrian-Hungarian Empire, The Dominions of the King of the Hellenes, The Dominions of the King of Italy, The Principality of Montenegro, The Principality of Roumania, The Dominions of the Emperor of Russia, The Dominions of the Sultan, including the Provinces of Bosnia and Herzegovina.

Secondly, sets forth the ports which had parts defined as foreign animals' wharves, namely, Goole, Grimsby, Hartlepool, London, Plymouth, Sunderland, and laid down regulations as to the time of the slaughter of animals landed in those wharves.

Thirdly, provided for the quarantine of foreign animals at a part of the port of Southampton defined as a foreign animals' quarantine station.

Fourthly, exempted animals from compulsory slaughter if brought from the following countries: Her Majesty's Possessions in North America, the United States of America, Denmark, Norway, Sweden, Spain, Portugal. Animals from these countries were to be landed at a place of landing approved by the Privy Council within one of the following ports: Bristol, Cardiff, Falmouth, Glasgow, Goole, Granton, Grimsby, Hartlepool, Leith, Liverpool, London, Newcastle-upon-Tyne, Plymouth, Portsmouth, Southampton, Sunderland, Weymouth. And general regulations were framed as to the slaughter and disposal of such animals if found diseased, and as to their ceasing to be deemed foreign animals if, after detention for not less than twelve hours, the whole cargo was certified by an inspector of the Privy Council to be free from disease.

Fifthly. Animals brought from the Channel Islands were exempted from compulsory slaughter, and subjected to the regulations last mentioned.

Sixthly. Animals brought from the Isle of Man were exempted from all restrictions relating to importation.

The first Order passed during the year 1879, relating to importations, was that dated the 10th of February, which ordered that from and after the 3d day of March, then next, cattle brought from the United States of America should cease to be exempted from the regulations regarding slaughter; or, in other words, provided that they should be landed in a foreign animals' wharf for slaughter.

On the 13th of February an Order was passed providing that cows or goats taken on board a vessel in Great Britain, for the purpose of supplying the passengers or crew with milk on a voyage were not, on being landed in Great Britain at the end of the voyage, to be deemed foreign animals, if the Customs were, before the same were landed, satisfied that they had been taken from Great Britain and had not been landed in a foreign country, and had not been in contact with any foreign animal.

On the 28th of February a foreign animals' wharf was defined at the Wallasey landing-stage at Birkenhead in the port of Liverpool. This became necessary in consequence of the passing of the beforementioned order No. 467, relating to cattle from the United States of America.

Middlesbrough was opened for the landing of foreign animals for slaughter by having a foreign animals' wharf on the south side of the river Tees, near Commercial street, defined by Order dated the 25th of March. Hull was also opened for animals for slaughter by having a foreign animals' wharf defined by Order dated March 25, and subsequently for animals not subject to slaughter or to quarantine, by Order dated the 28th of March.

Owing to the difficulty of carrying on the London-American cattle-trade in consequence of the only foreign-animals' wharf (The foreign-cattle market at Deptford) being situate high up the river, a temporary Order, to continue in force for two months, was passed on the 3d of April, permitting, from and after the 4th of that month, cattle brought from the United States of America to the port of London to be transshipped in the Victoria docks for conveyance to that market. This privilege was extended to American cattle transshipped in the Millwall docks by Order of Council dated the 8th of May. Just before the two last-mentioned Orders expired, another

Order was passed on the 29th of May, to take effect on the 4th of June, permitting animals (this Order did not confine the transshipment to cattle, as at that time American swine were also obliged to be slaughtered on landing) brought from the United States of America to the port of London to be transshipped in the river Thames, or in any dock within the port of London approved by the Privy Council, for conveyance to Deptford. The latter Order remained in force at the end of the year.

At the same time another Order was passed, also to take effect on the 4th of June, formally revoking the temporary Orders Nos. 475 and 481.

Difficulty having also been experienced at the ports of Hull and Glasgow in carrying on the trade in animals from America, owing to the great depth of water drawn by the vessels engaged in the trade, Orders were passed, on the 14th of May, permitting from and after that date, animals brought to the port of Hull from the United States to be transshipped in the river Humber or in the Albert dock for conveyance to the foreign animals' wharf at Citadel estate, and, on the 15th of August, permitting, from and after the 16th of that month, the transshipment of such animals brought to the port of Glasgow, in the Firth of Clyde or in the river Clyde for conveyance to the foreign animals' wharf at Yorkhill Wharf.

Owing to the accommodation at the Wallasey landing-stage at Birkenhead being found inadequate for the trade, the wharf was enlarged. It therefore became necessary to revoke the former defining Order, No. 470, and to redefine the wharf. Two Orders were accordingly passed, on the 8th of April, to effect that object.

Although Goole was inserted in the foreign animals' Order No. 452 as a port having a foreign animals' wharf, it was not, in consequence of the inadequate accommodation provided, until the 8th of April that the wharf was finally approved and the Order defining it was passed.

Several cargoes of swine affected with swine-fever having arrived from America, an Order of Council was issued on the 8th of May, providing, in effect, that swine brought from the United States of America should be subject to the same restrictions as cattle, namely, that they should be landed in a foreign animals' wharf for slaughter. The Order was to have come into force from the 1st of June, but owing to other diseased cargoes arriving, that date was, by a subsequent Order passed on the 13th of May, altered to the 16th of May.

The authorities at the ports of Bristol and Cardiff desiring to import American cattle and swine applied to have parts defined as foreign animals' wharves. Accordingly, on the 13th of May, two Orders of Council were passed, one defining a wharf at Avonmouth Dock, in the port of Bristol, the other defining a wharf at the Roath Basin of the Bute Docks, in the port of Cardiff, as foreign animals' wharves.

The American trade increasing at Liverpool, it was again found necessary to provide further accommodation. This necessitated the issuing of the following Orders: On the 16th of May the order of the 8th of April, No. 477, was revoked, and another defining Order was passed redefining the wharf as again enlarged at the Wallasey landing-stage at Birkenhead, and defining also a second foreign animals' wharf at the Woodside landing-stage at Birkenhead. On the 4th of July another foreign animals' wharf was defined on the Liverpool side of the Mersey, known as Huskisson Branch Dock No. 2; and, finally, on the 28th of July, still further accommodation having been found necessary, the two Orders then in force, Nos. 488 and 498, were rescinded, and the Order which remained in force to the end of the year, defining all three wharves, was passed.

On the 23d of May an Order was issued extending the time from ten days to fourteen days within which animals in foreign animals' wharves must be slaughtered. This regulation came into operation on the 25th of May.

On the 29th of May the usual Annual Order was passed providing for the landing, from the 31st of May to the end of the year, of cattle from the provinces of Schleswig and Holstein, in Germany, at a foreign animals' wharf for slaughter. This was necessary in consequence of cattle from the German Empire being otherwise still prohibited.

South Shields had a foreign animals' wharf defined at Tyne Dock by Order dated the 13th of June. The wharf, however, not proving sufficiently large for the trade, that Order was revoked, and a new Order issued redefining the same wharf with a further area on the 15th of August.

Glasgow had a foreign animals' wharf defined at Yorkhill Wharf by Order on the 23d of June, but which was revoked on the 27th of October, and the wharf was redefined on the latter date.

It having been decided by the admiralty that the Royal William Victualling Yard at Plymouth, which had been defined as a foreign animals' wharf by Order No. 459, should be used exclusively for naval purposes, that Order was revoked on the 21st of July, and on the same day another Order was passed defining as foreign animals' wharves, for naval purposes only, the Royal William Victualling Yard at Plymouth and the Royal Clarence Victualling Yard at Portsmouth.

On the 17th of September a second foreign-animals' wharf for the port of Bristol was defined at the Cumberland Tidal Basin in the town of Bristol.

The port of Harwich was opened for the importation of foreign animals not subject to slaughter or to quarantine on the 11th of October.

Barrow-in-Furness had a foreign animals' wharf defined at Ramsden Dock on the 11th of October.

On the 4th of November an Order of Council was passed ordering sheep to be landed in a foreign animals' wharf for slaughter if brought from the United States of America. The order took effect from the 23d of November, and was issued in consequence of sheep from that country having been found on landing to be affected with foot-and-mouth disease.

A foreign animals' wharf was defined at Southampton on the Southampton Dock Company's premises, known as the Extension Quay, on the 7th of November; and

The Order of Council defining a foreign animals' wharf at Middlebrough, passed on the 25th of March, No. 473, was revoked, and that port was opened for the importation of foreign animals not subject to slaughter or to quarantine, by Order dated the 29th of November.

The only other Orders affecting importation passed during the year 1879 were the revocation Order, No. 522 (revoking all former Orders except such local Orders as it was intended should remain in force, and the general Order relating to dairies and cow-sheds), and the Animals' Order, No. 523, consolidating all General Orders in force (except the General Order relating to dairies and cow-sheds). Both these Orders are further noticed under the heading *consolidating orders.*

The following statement will show the places where foreign animals could be landed on the 31st of December, 1879:

Barrow-in-Furness.—Barrow-in-Furness has one foreign animals' wharf: (*a*) Ramsden Dock (O. C. 514); but is not open for animals not for slaughter.

Bristol.—Bristol has two foreign animals' wharves: (*a*) Avonmouth Dock (O. C. 484); (*b*) Cumberland Tidal Basin (O. C. 512); and has two landing places for animals not for slaughter: (1) Railway Dock, (2) Avonmouth Dock.

Cardiff.—Cardiff has one foreign animals' wharf: (*a*) Roath Basin (O. C. 485); but is not open for animals not for slaughter.

Falmouth.—Falmouth has not a foreign animals' wharf, but has one landing-place for animals not for slaughter, (1) Penryn Wharf.

Glasgow.—Glasgow has one foreign animals' wharf: (*a*) Yorkhill Wharf (O. C. 516); and has one landing-place for animals not for slaughter, (1) Plantation Quay.

Goole.—Goole has one foreign-animals' wharf: (*a*) Railway Dock (O. C. 478); but is not open for animals not for slaughter.

Granton.—Granton has not a foreign-animals' wharf, but has two landing-places for animals not for slaughter: (1) Granton Harbor, (2) Granton Quay.

Grimsby.—Grimsby has one foreign-animals' wharf: (*a*) the 70-foot lock of the Royal Dock (O. C. 456); and has one landing-place for animals not for slaughter: (1) Royal Dock.

Hartlepool.—Hartlepool has one foreign-animals' wharf: (*a*) west side of the Jackson Dock (O. C. 457); and has one landing-place for animals not for slaughter: (1) Southeast corner of the Jackson Dock.

Harwich.—Harwich has not a foreign-animals' wharf, but has one landing-place for animals not for slaughter: (1) Great Eastern Railway Company's Pier.

Hull.—Hull has one foreign-animals' wharf: (*a*) Citadel Estate (O. C. 472); and has two landing-places for animals not for slaughter: (1) Albert Dock; (2) Quay-wall of Albert Dock.

Leith.—Leith has not a foreign-animals' wharf, but has two landing-places for animals not for slaughter: (1) Albert Dock; (2) Victoria Dock.

Liverpool.—Liverpool has three foreign-animals' wharves (O. C. 505): (*a*) Huskisson Branch Dock No. 2, Liverpool; (*b*) Wallasey landing-stage, Birkenhead; (*c*) Woodside landing-stage, Birkenhead; and has six landing-places for animals not for slaughter. (For all animals:) (1) Canada Dock, Liverpool; (2) shed on the north side of the Alfred Dock, Birkenhead; (3) inclosed space on the east of the before-mentioned shed, Birkenhead; (4) inclosed space on the northeast corner of the Great Float, Birkenhead. (For animals other than cattle:) (5) Southern end of the Wallasey landing-stage, Birkenhead; (6) sheds No. 4, No. 6, and No. 8, on the south side of the Wallasey Dock, Birkenhead.

London.—London has one foreign-animals' wharf: (*a*) Foreign Cattle Market, Deptford (O. C. 458), and has three landing-places for animals not for slaughter: (1) Brown's Wharf; (2) Victoria Docks; (3) Thames Haven.

Middlesbrough.—Middlesbrough has not a foreign-animals' wharf, but has one landing-place for animals not for slaughter: (1) Taylor's Wharf.

Newcastle-upon-Tyne.—Newcastle-upon-Tyne has not a foreign-animals' wharf, but has one landing-place for animals not for slaughter: (1) Legal Quay.

Plymouth.—Plymouth has one foreign animals' wharf, for naval purposes only: (*a*) Royal William Victualling Yard (O. C. 502); and has four landing-places for animals not for slaughter: (1) Commercial Wharf; (2) Keyham Dock Yard; (3) Mill Bay; (4) Sutton Wharf.

Portsmouth.—Portsmouth has one foreign-animals' wharf, for naval purposes only; (*a*) Royal Clarence Victualling Yard (O. C. 502); and has one landing-place for animals not for slaughter: (1) Chamber Dock.

Southampton.—Southampton has one foreign-animals' wharf: (*a*) Extension Quay (O. C. 518); and has a foreign animals' quarantine station: (*b*) Southern side of the Close Dock (O. C. 461); and has one landing-place for animals not for slaughter: (1) Southampton Docks.

South Shields.—South Shields has one foreign-animals' wharf: (*a*) Tyne Dock (O. C. 509); but is not open for animals not for slaughter.

Sunderland.—Sunderland has one foreign-animals' wharf: (*a*) North Half Tide Basin (O. C. 460); and has one landing-place for animals not for slaughter: (1) Hudson Dock North.

Weymouth.—Weymouth has not a foreign-animals' wharf, but has one landing-place for animals not for slaughter: (1) Harbour Quay.

DISEASES AMONG FOREIGN ANIMALS LANDED IN GREAT BRITAIN.

The diseases which were detected by the Inspectors of the Privy Council stationed at the ports in Great Britain among foreign animals landed in this country during 1879 were pleuro-pneumonia, foot-and-mouth disease, sheep-scab, and swine-fever.

The diseased animals came from Canada, the United States of America, Belgium, France, Germany, and the Netherlands.

Pleuro-pneumonia.—The first cases of pleuro-pneumonia among foreign stock were detected by the inspector at Liverpool, in the latter part of January. The ship Ontario, from Portland, State of Maine, landed 197 cattle at Liverpool in January; two dead cattle were also landed; and on making a *post-mortem* of one of the carcasses the inspector detected the marked appearance indicative of pleuro-pneumonia. He forwarded portions of the lungs to this department, and an examination of the parts sent up was made by the officers of the department, when all the *post-mortem* appearances of pleuro-pneumonia, as observed in animals afflicted with that disease in this country, were found to exist. The cargo was therefore detained, and the assistant inspector of the department was instructed to proceed to Liverpool to assist the inspector at that port in his inspection of the living animals, and to report fully on the subject.

At this period no proper accommodation existed at the port of Liverpool for either the lairage or slaughter of foreign animals; these cattle had been placed in one of the sheds at the Huskisson Dock, where it would have been practically impossible to have slaughtered them; permission was therefore given for the removal of the apparently healthy cattle to the abattoir, where a further examination of them was made and the *post-mortem* appearances of all their lungs carefully noted, when it was found that a large number of the animals were suffering from interlobular emphysema, and the ordinary inflammatory diseases of the respiratory organs, viz., bronchitis, pneumonia, and pleurisy, the results of cold and exposure.

In twelve of the cattle the distinctive appearances of pleuro-pneumonia were observed.

On February 9 the disease was detected in a cargo of cattle which arrived in the Istrian from Boston, and on the following day an Order of Council was passed, which came into force on March 4, subjecting cattle from the United States to slaughter at the ports of landing.

With a view, however, to assist in the detection of any cases of pleuro-pneumonia which might arrive prior to this Order coming into operation the assistant inspector remained at Liverpool.

It occasionally happened that only one animal in a cargo was found diseased, but on the 16th of December the Illyrian arrived at Liverpool from Boston having 69 cattle on board; these animals were all slaughtered in the foreign-animals' wharf, and their lungs were examined by the inspector at the port, when pleuro-pneumonia was detected in no less than twelve cases. From the date of the detection of the first cases of pleuro-pneumonia among American cattle on January 26 to December 31, 137 cases of the disease have been reported among cattle forming part of 57 cargoes.

Foot-and-mouth-disease.—A noticeable fact in regard to this disease is that it appears to have prevailed to a very small extent on the continent of Europe. During the past year animals affected with foot-and-mouth disease have been received from Belgium, Holland, France, Germany, and the United States of America, and it appears to have chiefly manifested itself among sheep and swine, only one head of cattle which arrived from Harlingen having been found to be affected with that disease. The most important point in connection with this affection is the fact of its detection among sheep which arrived at the port of Liverpool from the United States of America, a country in which the existence of that disease does not appear to have been generally recognized.

On July 3 the steamship Bulgarian, from Boston, arrived at Liverpool with 1,307 sheep; on the following day they were examined by the inspector at that port, who detained the whole cargo on the suspicion that a certain number of them were affected with foot-and-mouth disease, and immediately communicated with the department. The chief inspector was instructed to proceed to Liverpool and report on the condition of these animals. An examination was made of the whole of the sheep, which resulted in the detection of 10 cases of foot-and-mouth disease. Some of the animals had evidently been affected in their feet for many days, while others had the disease in the early stage, recently ruptured vesicles between the claws being observable, and one which was in this condition was also affected in the mouth. As this was the first cargo of animals from America among which foot-and-mouth disease had been detected, it was considered desirable, in order to establish the true nature of the disease, to communicate it, if possible, to a healthy sheep in this country. For this purpose the feet of those animals which had vesicles upon them were sent to Professor Simmonds, the principal of the Royal Veterinary College, who succeeded in producing the disease by inoculation in a healthy sheep which had been in the college for many weeks, a fact which was communicated by Professor Simmonds to the Royal Agricultural Society at a meeting held in the following month.

Other cargoes of sheep containing affected animals were landed in Liverpool in the months of September and October, the feet of which were sent to the department by the inspector at the port, and in every instance there was abundant evidence of their having been affected with foot-and-mouth disease, in consequence of which all the sheep in these several cargoes were slaughtered at the port of landing.

In all, six cargoes of sheep in which cases of foot-and-mouth disease were detected arrived from the United States. An Order of Council was passed on November 4 and came into operation on November 23, which subjected sheep from that country to slaughter on landing.

Altogether during the past year 162 foreign animals, namely, 1 head of cattle, 77 sheep, and 84 swine, were found by the inspectors of the Privy Council at the various ports to be affected with foot-and-mouth disease. The number is the smallest which has been recorded since the year 1871.

Sheep-scab.—Cases of this disease have been detected in animals brought from Belgium, Germany, the Netherlands, the United States, and Canada. All the diseased sheep and those brought in the same vessel were slaughtered at the ports of landing.

The total number of cases of scab which were detected among foreign sheep during the year 1879 was 697. Of these, 13 came from Canada and 37 from the United States; the remainder from Germany, Belgium, and the Netherlands.

Swine-fever.—Some affected with this disease have occasionally been landed in this country from the continent of Europe, and when detected the diseased animals have been slaughtered and destroyed at the place of landing, under the supervision of the inspectors of the Privy Council. The number of cases has, however, been comparatively few, and it was not until this year that the necessity has arisen for ordering the slaughter of swine on account of this disease.

Swine-fever, which is generally recognized under the name of "hog cholera" in America, has been known to exist in that country for many years; and in a paper which was issued by the Department of Agriculture at Washington, dated February 26, 1878, it was stated that out of 2,447 counties in the States and Territories of the United States, returns had been received from 1,125 counties, which showed that out of 18,987,342 swine in those counties, 2,599,542 had become affected with "hog cholera," and that the money value of the losses amounted to no less a sum than $10,091,483 annually. With a disease so extensively prevalent among swine in the United States, it was only to be expected that at some early date animals affected with that disease would arrive in this country. Accordingly, as soon as a trade in swine between that country and the United Kingdom became established, it was found that diseased swine were being exported to this country.

On April 30, the steamship Antonio, from Philadelphia, having on board 334 swine, arrived in the port of Liverpool; she had originally shipped 444, of which 110 had died and had been thrown overboard, and 59 others which were dying presented all the symptoms of swine-fever; the whole cargo was therefore detained by the inspector of the port. On the following day the assistant inspector of the department proceeded to Liverpool and made an inspection of the living diseased animals and a *post-mortem* examination of several others, and ascertained that they had been suffering from swine-fever in a most severe form. The swine had been landed at Woodside, Birkenhead, where no proper arrangements had at that time been provided for their slaughter and dressing; and it having been represented to the Privy Council that under these circumstances great delay must necessarily arise if the slaughter was carried out at the landing-place, permission was given for the removal of those which the inspector at the port pronounced to be healthy to the abattoir at Birkenhead. This was carried out under the immediate supervision of an officer of the Local

Authority, while the carcasses of all the diseased animals were destroyed at a bone-boiling yard.

Other cargoes of diseased American swine having arrived in rapid succession, an Order of Council was passed on May 8, subjecting swine from the United States to slaughter on landing, after June 1. Meanwhile further cargoes of diseased animals having arrived, article 1 of that Order was revoked by an Order of Council passed May 13, by which the date of their compulsory slaughter was altered from June 2 to May 17.

A cargo of swine, consisting of 567 animals, arrived in the steamship Viking at the Victoria Docks, from Canada, on November 14; 42 of them were found to be affected with swine-fever. The inspector brought portions of the intestines of some of the animals which had been slaughtered to the department for examination, and it was apparent that the parts had been taken from animals affected with swine-fever. The assistant inspector of the department subsequently examined the animals, and found confirmatory evidence of the existence of the disease.

The diseased swine were all slaughtered at the landing-place, and those apparently healthy were removed to Deptford for slaughter in the foreign-animal wharf.

On December 13, a cargo of swine, among which swine-fever was detected, arrived from Montreal, Canada, at Glasgow; all these animals were slaughtered at the landing-place. No cases of this disease have been detected among swine received from the continent during the past year.

Altogether there have been landed during the year 1,044 animals affected with swine-fever. Of these, 974 came from the United States and 70 from Canada.

DISEASES WHICH HAVE EXISTED AMONG ANIMALS IN FOREIGN COUNTRIES IN 1878.

AMERICA.

HER MAJESTY'S POSSESSIONS IN NORTH AMERICA, AND THE UNITED STATES OF AMERICA.

No information of the existence of diseases among animals in Canada has been received during the year 1879, but the inspectors at English ports detected 13 sheep affected with sheep-scab, and 70 swine affected with swine-fever, on being landed in this country from Canadian ports.

Animals imported from Canada, if healthy, are not subject to slaughter at the port of landing. During 1879 there were landed 25,185 cattle, 73,913 sheep, and 3,663 swine from Canada. In 1878 the number was 17,989 cattle, 40,132 sheep, and 1,614 swine.

The Canadian Government has prohibited the importation of cattle from the United States into the provinces of Ontario, Quebec, Nova Scotia, and Prince Edward Island. This order remained in force at the end of the year.

Since the United States cattle have been slaughtered at the ports of debarkation in this country a considerable amount of interest has been aroused in the States in reference to the extent of the prevalence of pleuro-pneumonia among American cattle, and the veterinary department has received numerous papers from time to time from Her Majesty's minister at Washington, giving a detailed description of several outbreaks of that disease, and among the papers received is a report issued by the Commissioner of Agriculture, dated November, 1878, in which are the following statements:

"One of the most dreaded contagious diseases known among cattle is that of pleuro-pneumonia, or lung-fever. It was brought to this country as early as the year 1843, and has since prevailed to a greater or less extent in several of the Eastern and a few of the Southern States. It made its appearance about a century ago in Central Europe, and has since spread to most European countries. With the exception of rinderpest, it is the most dreaded and destructive disease known among cattle. Unlike Texas cattle-fever, which is controlled in our more northern latitudes by the appearance of frost, this disease knows no limitation by winter or summer, cold or heat, rain or drought, high or low latitudes. It is the most insidious of all plagues, for the poison may be retained in a system for a period of one or two months, or even for a longer period, in a latent form, and the infected animal in the mean time may be transported from one end of the continent to the other in apparent good health, yet all the while carrying and scattering the seeds of this dreaded pestilence. Since the appearance of this affection on our shores it has prevailed at different times in the States of Massachusetts, Connecticut, New York, New Jersey, Pennsylvania, Maryland, Delaware, Virginia, and in the District of Columbia. It has recently shown itself at two points in Virginia (Alexandria and Lynchburg), where it was recently prevailing in a virulent form. * * *

"The interests involved in this case are of so vast a character, and of such overshadowing importance both to the farming and commercial interests of the country, as to require the active intervention of the Federal Government for their protection. And for this reason the considerate attention of Congress is respectfully asked to this important matter."

In addition to this statement on the part of the Minister of Agriculture, accounts of the appearance of the disease in several of those States have been received from Her Majesty's minister at Washington, and outbreaks of a very fatal character have been referred to, more particularly in the States of New York, New Jersey, Pennsylvania, and Virginia. It also appears that several of these States have issued through their legislatures most stringent regulations for suppressing this disease, including the slaughter of diseased cattle and the inspection and quarantine of cattle imported from a neighboring State.

The power, however, to stop importation from a neighboring State has been disputed, and a decision has been rendered by the supreme court of the State of Illinois, as to the right of a State to protect itself from contagious diseases, that all State laws interfering with the free interchange of commerce between the different States are contrary to the Constitution of the United States, and show that any legislation for the purpose of suppressing any contagious diseases among cattle, to be effective, must emanate from the Congress of the United States.

On February 1, the American Government issued a circular to the collectors of customs in the United States, ordering that all cattle should be inspected before embarkation to Great Britain. A notice was also issued to the collectors of customs on March 7, ordering that neat cattle from England should not be landed until otherwise ordered; this prohibition was, however, modified in a circular which was issued on July 19, which stated that neat cattle from Europe would be admitted after a quarantine of ninety days.

A circular was issued on November 3, 1879, which came into effect on December 1, 1879, prohibiting the importation of neat cattle from Canada.

At the commencement of the year 1879 animals from the United States were not subject to slaughter on landing, but owing to the detection of pleuro-pneumonia among cattle, foot-and-mouth disease in sheep, and swine-fever in pigs, all animals from that country are now subject to slaughter at the port of landing. During 1879 there were imported from the United States 76,117 cattle, 119,350 sheep, and 15,180 swine, of which 137 cattle were affected with pleuro-pneumonia, 33 sheep with foot-and-mouth disease, 37 with sheep-scab, and 974 pigs with swine-fever. In 1878 the imports from the United States were 68,450 cattle, 43,940 sheep, and 16,321 swine.

CORRESPONDENCE CONNECTED WITH THE DETECTION OF PLEURO-PNEUMONIA AMONG CATTLE LANDED IN GREAT BRITAIN FROM THE UNITED STATES OF AMERICA.

No. 1.

Telegram from the Marquis of Salisbury to Her Majesty's minister at Washington, 30th January, 1879.

Pleuro-pneumonia having been detected in a cargo of cattle on board the ship Ontario, from Portland, Her Majesty's Government is consequently considering whether it can retain the United States under the exemption of Part IV of the fifth schedule of the act of 1878.

No. 2.

Letter from Sir E. Thornton to the Marquis of Salisbury.

WASHINGTON, *February* 3, 1879.

MY LORD: On the receipt of your lordship's telegram of the 30th ultimo, informing me that pleuro-pneumonia had been detected in a cargo of cattle on board the ship Ontario, from Portland, and that Her Majesty's Government was consequently considering whether it could retain the United States under the exemption of Part IV of the fifth schedule of the act of 1878, I called upon Mr. Evarts and communicated to him the contents of your telegram. He had also received one to the same effect from the United States minister in London. He said that the information had taken him by surprise, and that he had not yet made complete inquiries upon the subject. With regard to the cases of pleuro-pneumonia which had been discovered on board the Ontario, he thought it very probable that the animals had contracted the disease during the voyage, and that it had been caused by bad ventilation and exposure to rough weather. He believed that there were some cases of it in different parts of the United States, but that a few always existed. They were, however, isolated cases, and there was no ground whatever for supposing that the disease was epidemic. He added that measures had now been taken for the inspection of cattle for export at the different ports of the United States, and, as it was not in the interest of the owners to ship diseased cattle, they would certainly be careful to avoid doing so. Nothing, however, could prevent isolated cases of disease contracted on board of ship; but inspection on arrival at the port of destination, and slaughter in case of need, would preclude any danger of the spreading of the disease. He expressed his opinion that it would be hardly justifiable to stop so great a trade and to prevent the supply of food from reaching Great Britain on account of a few isolated cases of pleuro-pneumonia, which in this country was not considered contagious.

Before I saw Mr. Evarts he had sent me a short note, a copy of which I have the honor to inclose, informing me that an agent of the British Government had been for some days past at New York and Alexandria, and had reported to the Canadian Government the existence of pleuro-pneumonia among cattle. I had not then received his note, but he told me its contents, and asked me whether I could give him any information with regard to the agent in question. I was obliged to acknowledge that I had neither seen nor heard of him.

The next morning I addressed an official note to Mr. Evarts, transmitting him a copy of your lordship's telegram of 30th ultimo.

I also received on that morning a private letter from the acting consul at Philadelphia, of which, and of its inclosure, I have the honor to inclose a copy. From this it appears that Prof. D. McEachran, Veterinary Inspector of Canada, had been sent by the Government of the Dominion to inspect cattle in this country, and was doubtless the person to whom Mr. Evarts had alluded. It would appear that he ascertained that there had been many cases of the disease in Virginia and that he discovered that it prevailed to a great and severe extent in a large cow-house near Brooklyn, Long Island.

On the 1st instant I again called upon Mr. Evarts and read to him the greater part of Mr. Crump's and Dr. Gadsden's letters. He still, however, expressed his opinion that these cases did not affect the general cattle of the country, and particularly those which were exported.

Mr. Evarts informed me that he had made inquiries with regard to the cargo of the Ontario. It appeared that the bulk of the cargo were American cattle, but a few, about twenty-two, were Canadian. He did not know among which of these the cases of pleuro-pneumonia had been discovered. When these cattle were about to be shipped the collector of customs had offered to order an inspection of them and provide them with a certificate, but their owner declined an inspection, on the ground that a certificate would not be required in England.

It is probable that should Her Majesty's Government still allow cattle to be imported from this country, a very strict supervision will be exercised over them at the ports of embarkation, and care will be taken to prevent the shipment of diseased cattle.

Mr. Evarts sent me a copy of a telegram which he forwarded on the 1st instant to Mr. Welsh, a copy of which I have the honor to inclose.

I have made inquiries of several persons in and about Washington as to the prevalence of pleuro-pneumonia among cattle in the neighborhood. I find that there are isolated cases of the disease here and there, but many less than in June last, when there were several deaths on account of it. The cases seem to be confined to milch cows, and more particularly to those kept in stables.

In the latter case the disease will attack a good many cows, but will not spread outside the stable, and seems to be due to local causes.

Dr. Fairfax, a gentleman of English descent, who has lived for many years on a farm in Maryland, nine or ten miles from here, who is thoroughly acquainted with such matters, and whose statements can be entirely relied upon, says that the disease in this country is not the same as in England; that it is not considered to be contagious, and that it has not become epidemic, although it will spread in a stable where the animals are subjected to the same local circumstances.

I have this afternoon received a telegram from the Governor-General of Canada, informing me of the Order of the Privy Council of the Dominion, prohibiting, for three months from the 1st instant, the introduction of cattle from the United States into the different provinces of the Dominion.

I have, &c.,

EDWARD THORNTON.

[Inclosure 1 in No. 2.]

Letter from Mr. Evarts to Sir Edward Thornton.

DEPARTMENT OF STATE, *Washington, January* 30, 1879.

MY DEAR SIR EDWARD: I have received information that an inspector of the British Government has been in New York and Alexandria for some days past, and has reported to the Canadian Government the existence of pleuro-pneumonia among cattle.

I presume that information to the same effect may have been communicated to you by him. I am not myself aware of the existence of the disease, but as the cattle trade between this country and Great Britain is of so great importance, and as any interruption of it is likely to have such serious results, I shall be very glad, indeed, to be informed of any intelligence which you may have received upon the subject, or to confer with you.

I am, &c.,

WM. M. EVARTS.

[Inclosure 2 in No. 2.]

Letter from Mr. Crump to Sir Edward Thornton.

BRITISH CONSULATE, PHILADELPHIA, UNITED STATES. (No date.)

I think I ought to write you with reference to the latest development in the cattle disease. You may not be aware that Prof. D. McEachran, Veterinary Inspector of Canada, who, I am told, was introduced to you in Canada, has been through some of the cities of the United States on a confidential mission inspecting cattle, particularly with reference to the existence of pleuro-pneumonia. He was in this city, Washington, and Virginia last week, and returned to Canada a few days ago, after making inspections on Long Island that resulted in painful developments. I am informed that he did not desire to visit any official of the Imperial Government, as he was not instructed to do so; that he did not call upon you while he was in Washington, and declined a pressing invitation to confer with me while in this city. He discovered in Williamsburg, near Brooklyn, a shocking state of things. There is a byre, a cow-house, connected with a distillery, where cows are housed to the number of 800 at a time, and fed with hot swill running along the troughs in front of the cattle connected with the distillery. The object to be attained is to increase the production of milk, which is obtained to an extraordinary extent. The cattle never get out of this place in a healthy condition, and but few alive, the pleuro-pneumonia killing them off, several per day, or rather they are sold for a small sum before death to Jew dealers, who kill and dress the meat for New York, to be retailed, not to Jews, but only to the Christian consumers. A few young cattle, when first infected, are returned to the country, there, in all probability, to spread the disease. The milk and meat of these animals are dangerous to the human system. They are not allowed to be sold in Brooklyn, but can be passed through that city to New York. The temperature of the numerous cases of pleuro-pneumonia examined by Dr. McEachran was as high as 105°, and in some cases 107°, showing the most virulent type of the complaint. The animals get no exercise whatever, leaving their stalls, to which they are chained, for slaughter when attacked by the contagion. The filth, heat, and fetid steam of the place, it is reported, are of the most revolting character. Dr. McEachran's entrance into this place was clandestine, and, upon being discovered, he narrowly escaped personal violence. I have requested my informant, a veterinary surgeon of this city, of ability, and the highest character in the city, Dr. Gadsden, to write me a letter. He has done so, and I beg to forward it to you.

I should also state that Dr. McEachran found much pleuro-pneumonia in Alexandria, Va., where two or three hundred cases terminated fatally last year. He says the complaint extends all over the State of Virginia. Dr. McEachran has returned to Canada with a determination to have steps taken for the protection of the Canadian stock-yards from this infection and the stigma that will follow the disclosure of these facts.

To-day cable news has been received in this city that a cargo of live cattle from Portland had been found afflicted with pleuro-pneumonia on arrival at Liverpool, and the animals were all killed. This news came to Eastman, of New York, the largest shipper in the country, and who is said to be carrying out the plans of Vanderbilt and the New York Central Railway. Other cable news has been received that steps are about to be taken to forbid the landing of cattle from American ports. Samuel Allerton & Co., of Chicago, the largest shippers of dead meat, and from this port, as well as others engaged in this fast-becoming most important trade, are much exercised.

A certificate of inspection of a cargo of live cattle per steamship Lord Clive, sailed to-day from Philadelphia to Liverpool, was presented to me for authentication, but as I did not know the character of the inspector I declined to certify to it. Subsequently, however, when it was returned attested by the collector of the port, that the inspector was appointed by him to perform the duty, I certified to the official act of the collector.

The merchants here engaged in the trade are willing to adopt any plan that I may suggest to them, regardless of the expense, to insure the shipment of healthy animals and meat to England.

Dr. McEachran made no discoveries in this district unfavorable to the general healthy condition of the cattle.

P. S.—Dr. McEachran had a long interview with the Commissioner of Agriculture in your city. I believe he did not visit Boston. Large numbers of live cattle are shipped from Boston in the winter, which come originally from Canada, and are on Canadian account.

[Inclosure 3, No 2.]

Letter from Mr. Gadsden, M. R. C. V. S., to George Crump, Esq.

134 NORTH TENTH STREET, PHILADELPHIA, *January* 28, 1879.

Knowing you wish all the information respecting contagious diseases of cattle, I send you a report of my examination of some with Prof. D. McEachran, the Veterinary Inspector of Canada, who was sent by his government to investigate it and report at once.

The inspector called on me first on his way to Washington (18th instant); again on the 23d of this month, when he reported to me he had examined several cases of contagious pleuro-pneumonia in cattle at Alexandria, Va.

I started with him on the 24th to New York to find out the truth of the report that a contagious disease was prevalent on Long Island. We found very many cases of contagious pleuro-pneumonia in a large byre, or cow-house, containing about 800 cows (all in a filthy condition), at Williamsburg,* near Brooklyn. This large cow-house adjoins the distillery of Gaff, Fleishman & Co., where they are fed on hot swill and hay, to force the milk. This place is a regular pest house for the disease; the cows belong to a large number of milkmen, who pay a small sum (77 cents per cow a week) for the stall and swill. It is quite impossible for me to inform you how many of these 800 cows have the disease at the present time, but I should think from what I saw that several hundred have it now, and it is only a question of time for all the others to take it. The men would not allow us to examine many of them in one part; we found very few healthy cows there. We made a *post-mortem* examination of the lungs of one of the cows that had this disease in the last stage, which leaves no doubt of its character, as all the pathological anatomy of this malady was present (one lung was very heavy and quite solid). Just before the cows die they are killed and sent into New York market as good beef (at night).

From inquiry made by us from cattlemen and veterinary surgeons at Brooklyn, we have no doubt that this disease is prevalent in many parts of Long Island, as these diseased cows from Williamsburg are often sent away alive to other parts of the island.

I have made inquiry from several veterinary-surgeons in Pennsylvania, but cannot hear of any contagious diseases in cattle in that State.

[Inclosure 4 in No. 2.]

Telegram from Mr. Evarts to Mr. Welsh, United States Minister, London.

FEBRUARY 1, 1879.

Cattle by Ontario, part Canadian, part Western. Inspection offered by government was declined by shippers on their view that British regulations did not require it. There is no evidence of any disease in the cattle of this country that affects domestic or foreign trade in them. This government would regard any proscription of our trade in live cattle as wholly unjustified by any condition of things known or suspected here. The appearance of pleuro-pneumonia in a cargo at the end of a voyage can scarcely warrant a restriction of this trade with a country free from any epidemic among cattle. Communicate to Salisbury.

---

* Blissville is no doubt meant.

No. 3.

Letter from the United States Minister, London, to the Marquis of Salisbury.

LEGATION OF THE UNITED STATES, *London, February* 4, 1879.

MY LORD: The arrival of the Dominion steamer "Ontario" from Portland last week at Liverpool, with a number of cattle, a few of which were said to have had the pleuro pneumonia, has been the occasion of much anxiety to those who have recently embarked very largely in the importation of cattle from the United States.

It has been asserted in the newspapers that these cattle were brought from Chicago and Buffalo, in the United States, and further, that an expert, having been employed by the Canadian authorities for the purpose, had visited the United States and found in Washington and elsewhere some cattle affected by the disease.

These circumstances have caused me to make such inquiries as were essential to an understanding of the facts of the case, the results of which I beg to place before your Lordship.

From reliable parties in Liverpool I learn that while a part of the cattle by the Ontario came from Chicago and a part from Buffalo, at least 45 head of them came from Toronto, and were so mixed with the others that the Canadian and the United States cattle could not be distinguished. It is also beyond dispute that those which came from the United States passed for several hundred miles over the Grand Trunk road through the Dominion of Canada; that all the cattle were exposed to weather of unusual severity; that they remained for a considerable time in Portland without food or water; and that they had undergone an exceptional amount of hardship and bad usage before entering upon a voyage which was made at an inclement season and during excessively rough weather. Under these circumstances it is strange that so few were found whose lungs were diseased. In fact, the fact that so few were found diseased is almost a conclusive proof that they were healthy when they left their several places of departure, for had they been then affected by a contagious or infectious malady, as the pleuro-pneumonia is asserted to be, would it not have been communicated to most, if not to all, of the herd?

What I have just narrated is the result of my inquiry on this side. So soon as the report reached me I telegraphed to the Department of State at Washington for the facts, both in regard to this special case and to the existence of pleuro-pneumonia among the cattle in the United States. Mr. Evarts replied as follows:

"Cattle by Ontario, part Canadian, part Western. Inspection offered by government was declined by shippers on their view that British regulations did not require it. There is no evidence of any disease in the cattle of this country that affects domestic or foreign trade in them.

"This government would regard any proscription of our trade in live cattle as wholly unjustified by any condition of things known or suspected here. The appearance of pleuro-pneumonia in the cargo at the end of a voyage can scarcely warrant a restriction of this trade with a country free from any epidemic among cattle."

The accounts from both sides, so far as this cargo is concerned, seem to me not to warrant the inference that the pleuro-pneumonia exists either in Canada or the United States; but if the few cattle which were diseased really had it, the hardships and exposure which they underwent are sufficient to account for it.

Your lordship should not lose sight of the fact that our laws exclude the importation of all cattle from Europe into the United States on account of the fear of disease, unless under the special permission of the Secretary of State, and then only of such kinds as are needed for breeding purposes.

Since the arrival of the Ontario several vessels have reached here from the United States with cattle which were entirely healthy.

I trust it will prove that the alarm which has arisen from this single case has been quite unnecessary, and that nothing further will occur to check the development of a trade which promises such large employment for the tonnage of Great Britain, and an advantageous market for the abundant herds of America. I am quite sure, however, that in no event will your lordship allow of hasty and inconsiderate action unfavorable to the interests of the United States.

It will come to the knowledge of your lordship from authoritative sources that the representatives of about one-third of the entire steam tonnage of the United Kingdom, the Ship-owners' Association of Liverpool, believe that the true interests of the people of Great Britain are to be promoted, not by a greater restriction in existing rules, but by their enlargement, so that the cattle coming from North America shall be subject to the same regulations which control cattle coming from Ireland, and from one port in the Kingdom to another.

I have, &c.,

JOHN WELSH.

No. 4.

Letter from the United States Minister, London, to the Marquis of Salisbury.

LEGATION OF UNITED STATES OF AMERICA, *London, February* 7, 1879.

MY LORD: Since I wrote you on the subject of the transit of cattle from America, and the alarm which the few cases of disease on the Ontario had occasioned, the following vessels, viz., the Victoria, England, State of Alabama, Illyrian, Pembroke, and Iberian have arrived at Liverpool, and discharged their several parcels of cattle without a single case of disease, all having passed after a most critical inspection. Notwithstanding this, rumors exist in Liverpool that the Privy Council will, at an early day, put the United States on the schedule, and subject all cattle coming thence to slaughter on arrival. This has created the greatest alarm, because of the large interests involved, and, as it is claimed, of the great injustice to which the parties will be subjected without any adequate notice.

The freedom from disease in the cattle from the United States which have hitherto been brought to England, and among recent arrivals, seem to me to forbid any action which would be so serious in its consequences, or even any interruption in the trade now existing, and I shall be glad to be authorized by you to say that the present apprehensions are unfounded.

I have, &c.,

JOHN WELSH.

No. 5.

Letter from the Clerk of the Council to the Under Secretary of State, Foreign Office.

VETERINARY DEPARTMENT, PRIVY COUNCIL OFFICE,
44 PARLIAMENT STREET, WESTMINSTER, S. W., *February* 12, 1879.

SIR: I have submitted to the Lords of the Council your letter of the 8th instant, inclosing copies of two notes from the United States Minister respecting the cases of pleuro-pneumonia recently detected at Liverpool among cattle, ex-Ontario, from the United States, and deprecating any increase of the restrictions in the cattle trade with America.

In reply, I am directed to state, for the information of Lord Salisbury, that in consequence of the reports which have reached the Lords of the Council of the existence of pleuro-pneumonia in the United States of America, coupled with the fact that animals affected with that disease have been landed at Liverpool, their lordships have no option under the terms of the contagious diseases (animals) act, 1878, but to revoke that portion of the Order of Council by which the United States were exempted from the provisions of that act.

I beg to inclose a copy of the Order of Council which the Lords of the Council have considered it necessary to pass, and which comes into operation on the 4th proximo.

I am, &c.,

C. L. PEEL.

[Inclosure in No. 5.]

At the Council Chamber, 467 Whitehall, the 10th of February, 1879.

By the Lords of Her Majesty's Most Honorable Privy Council.

Present: Lord President, Lord John Manners.

The Lords and others of Her Majesty's Most Honorable Privy Council, by virtue and in exercise of the powers in them vested under the contagious diseases (animals) act, 1878 (in this order referred to as the act of 1878), and of every other power enabling them in this behalf, do order, and it is hereby ordered, as follows:

1. This Order shall take effect from and immediately after the 3d day of March, 1879, and words in this order have the same meaning as in the act of 1878.
2. This Order extends to Great Britain only.
3. Article 13 of the Foreign Animals Order is hereby revoked, as far as it relates to cattle brought from the United States of America, and declares that the same may be landed without being subject under the act of 1878, or under that Order, to slaughter or to quarantine.

C. L. PEEL.

[No. 6.]

Letter from the British Consul-General at New York to the Marquis of Salisbury.

BRITISH CONSULATE-GENERAL, *New York, January* 30, 1879.

MY LORD: I have the honor to report to your lordship that in order to obtain the latest and most authentic information in regard to the sanitary condition of animals in this consular district, I addressed on the 24th instant a circular letter to the secretaries of the respective State governments of New York, New Jersey, Connecticut, Delaware, and Rhode Island, in this consular district, calling attention to the statements of a professor of veterinary science that cases of pleuro-pneumonia are not infrequent in these States, and requesting to be furnished with any information in their possession on this subject; requesting also that my communication might be referred to the State agricultural department or society, and asking that the desired information should be furnished to me as speedily as possible.

In case of the known existence of any cases, requesting further that, with regard to the nature of the disease, it might be stated whether or not it is regarded as contagious, had become epidemic, to what extent it had proved fatal, the treatment adopted for its cure, and what, if any, provision had been made for arresting its extension.

I received from the secretary of state of the State of New York a reply, of which I inclose a copy, informing me that that department has no knowledge relative to pleuro-pneumonia existing among animals in this State. From the secretary of the State agricultural society, with whom I also communicated, I received replies, of which I inclose extracts, from which it will be seen that he questions the existence of contagious pleuro-pneumonia in this country.

I inclose also copies of the last annual report of the society, recently adopted, in which, while reference is made to the act of the legislature of last year respecting infectious and contagious diseases of animals (copies of which I transmitted to Her Majesty's legation at Washington in September last), no allusion whatever is made to the existence of contagious diseases among live stock in this State.

From the State of Connecticut, however, I have received a letter from Mr. T. S. Gold, one of the commissioners on diseases of domestic animals, of which I inclose a copy, reporting the outbreak of contagious pleuro-pneumonia in one herd of cows in the town of Watertown, in that State. He adds that the disease is not epidemic, but is confined to this one herd, which is strictly quarantined; that the commissioners know of no other cases in the State, and are quite sure that none others exist.

In regard to the State of New Jersey, I have received from a member of the State board of health a letter, of which I inclose a copy, informing me that he has recently investigated the sanitary condition of live stock in that State, and finds that contagious pleuro-pneumonia has existed, and at the present time does exist, to a more or less degree. That so far as he can learn it has never assumed the epizootic form. That at the present time it is found in isolated cases, which might be the means of superinducing an outbreak.

From the States of Delaware and Rhode Island I have as yet received no replies to my inquiries.

On receipt of the communication from Connecticut and the statement therein of the supposition that the disease had been imported from New York in August last, and upon a report made to me that pleuro-pneumonia among cows was supposed to lurk in some of the dairies in the suburbs of New York and Brooklyn, more especially in dairies in connection with large breweries, I addressed a letter to the respective mayors of the two cities, calling their attention to the matter, and requesting that an investigation might be made, and that I might be informed of the result.

I think it well to inclose a copy of a letter from the agricultural editor of the American Agriculturist, supposed to be well informed in such matters, stating that among grazing cattle there is now no disease reported in any part of the country; that occasionally a few cases of pneumonia occur in ill-conducted dairies, but that it is not of an epizootic character, and remains in the States where it originated. He concludes by stating that there now is none of this existing, a conclusion, however, which is at variance with the positive reports from Connecticut and New Jersey.

I have to-day seen and conversed with Mr. Eastman, who is the principal shipper of fresh meat from this port, and who in the summer time has exported live stock from hence to Great Britain. He largely supplies this market, and handles about 2,500 head of cattle every week. He assures me that in the Western States, from whence he draws his supplies, there are absolutely no diseases—certainly no contagious diseases—among cattle.

In pursuance of the information which I had received, I yesterday transmitted to your lordship the following telegram:

"A few isolated cases of pleuro-pneumonia among horned cattle have appeared within this consular district. Fuller report by post."

E. M. ARCHIBALD.

[Inclosure 1 in No. 6.]

Letter from Mr. Allen C. Beach to E. M. Archibald, Esq., Her Britannic Majesty's Consul-General, New York.

STATE OF NEW YORK, OFFICE OF THE SECRETARY OF STATE,
Albany, January 28, 1879.

In answer to your favor of the 24th instant, I have the honor to state that this department has no knowledge relative to pleuro-pneumonia existing among animals in this State.

I have applied to the secretary of the State agricultural society, who I thought would be most likely to give you the information desired, and am informed that he has written you in full upon the subject.

[Inclosure 2 in No. 6.]

Letter from Secretary New York Agricultural Society to E. M. Archibald, Esq., Her Britannic Majesty's Consul-General, New York.

JANUARY 24, 1879.

I am in receipt of your letter of yesterday, and have much pleasure in sending a copy of the report made by the executive committee to the general meeting of the society on Wednesday last. The society's report to the legislature has not yet been presented.

I am not in possession of any other information on the subject of the disease among cows near Washington other than that given in the New York Tribune, and I very much distrust the diagnosis given in that paper, and based upon report only. It would seem that had the disease been the contagious lung plague (pleuro-pneumonia) of Europe, we should have heard of larger losses and of continued mortality.

We have never been called upon to investigate a case of pleuro-pneumonia. We have frequently had to send to investigate mysterious outbreaks of disease reported in the newspapers, but they have invariably turned out to be splenic apoplexy (anthrax.) The only diseases of cattle that have ever occurred as epidemics in our cattle markets are Texan fever and the foot-and-mouth disease. The former has given no cause for alarm since 1868, except locally, and in one town and on only one farm in 1877, where it disappeared almost before we had time to be sure of its identity. The latter did not survive the first winter after its importation, and if it occurs again it will be from a new importation.

As to pleuro-pneumonia, which in one form is of course contagious (and probably the hardest of all diseases to get rid of), opinions differ as to whether it exists in this country or not. Professor Law, in the paper which he read at our annual meeting in 1876 (see our Transactions, volume xxxii), probably puts the case for the affirmative as strongly as possible. On the other hand, there is the fact that we hear of no cases in recent years of disease supposed to be pleuro-pneumonia, or pronounced to be by any competent authority. The last report of it that I know of was by Professor Cressy to the Connecticut Board of Agriculture, in 1874, and in that case the identification of the disease with the contagious pleuro-pneumonia of Europe seems to be doubtful, because the animals were purchased in the autumn and remained sound until the spring; whereas three months is the longest period of incubation claimed for the disease by Professor Law and two months by Gamgee (Domestic Animals in Health and Disease, vol. 1, page 602). I am, therefore, inclined to believe the Connecticut disease to have been the sporadic pleuro-pneumonia described by Gamgee (in the work cited) rather than the contagious form. It seems hard to believe that so fatal a disease should be lurking, as some maintain that it is, among the dairies of the lower class in the neighborhood of our large Atlantic cities without spreading and without causing such loss as to attract attention; but if such be the fact, the situation of our important cattle markets and the way in which the movement of cattle is carried on render it almost impossible that the disease can become epidemic.

[Inclosure 3 in No. 6.]

Letter from Secretary New York Agricultural Society to E. M. Archibald, Esq., Her Britannic Majesty's Consul-General, New York.

JANUARY 25, 1879.

In reply to your note of yesterday, I have to say that if it was Professor Law who wrote the article in the Tribune of 27th of November, it accounts for the very decided tone in which the Washington disease was pronounced to be contagious pleuro-pneumonia.

As to the disease which under the name of pleuro-pneumonia has occurred, or has been reported occasionally of late years in the United States, being identical with the contagious pleuro-pneumonia of Europe I very much doubt for the reasons given in my letter of yesterday.

It is generally admitted, and supposed to be established, that the disease imported in Mr. Chenery's Holland cattle at Boston in 1859, and in Mr. Richardson's shorthorns in 1847, was contagious pleuro-pneumonia. In both these cases the disease is believed to have been extirpated.

The foundation for the statement that the same disease came to this country in 1843 and in 1850 I do not know. Writing in 1860 on the subject of the disease then prevailing in Massachusetts, the late Mr. B. B. Johnson, the secretary of this society, used the following language:

"At the same time it may be proper to note that, according to evidence too full and well authenticated to be rejected, pleuro-pneumonia has in several instances made its appearance in this country previous to its introduction by Mr. Chenery's importations. Cases in past years in the vicinity of several of our cities, of its attacks, and subsequent entire extirpation, have been brought to our notice in detail," &c.—(Transactions New York State Ag. Soc., 1859, p. 783.)

I think it may properly be inferred from this language that in 1859 we supposed the country to be free from pleuro-pneumonia of the contagious form, and we know that the authorities of Massachusetts considered that in 1861 they had completely rid that State of the contagion imported in 1859. I am not in a position to assert that there has been no later importation. I can only say that I have never heard of any.

[Inclosure 4 in No. 6.]

Letter from T. S. Gold, Esq., to E. M. Archibald, Esq., Her Britannic Majesty's Consul-General, New York.

JANUARY 29, 1879.

Yours of 24th instant has been referred to me by the Honorable Secretary of State, and in reply would say that one herd of cows in Watertown is suffering at present with pleuro-pneumonia. Of 19 head, four have died, one sick cow has been killed, and most of the others are affected. It is plainly contagious, and we attribute the disease to two cows brought from New York in August. It is not epidemic, but is confined to this one herd, which is strictly quarantined. We know of no other cases in this State, and we are quite sure that none exist.

One or two similar outbreaks have been controlled by slaughter and quarantine.

Dr. Noah Cressy, V. S., is treating this herd, principally relying upon alcoholic stimulants, but it is too early to speak of results.

[Inclosure 5 in No. 6.]

Letter from Henry C. Kelsey, Esq., to E. M. Archibald, Esq., Her Britannic Majesty's Consul-General, New York.

JANUARY 9, 1879.

Your favor of the 24th instant is this day referred to William M. Force, Esq., Newark, N. J., Secretary of the State Agricultural Society, for answer.

[Inclosure 6 in No. 6.]

Letter from Mr. J. C. Corlies, D. V. S., to E. M. Archibald, Esq., Her Britannic Majesty's Consul-General, New York.

NEWARK, N. J., *January* 28, 1879.

My esteemed friend, Mr. W. M. Force, has requested me to answer a communication conveyed to him through the State Department from yourself in reference to pleuro-pneumonia as existing in the Atlantic coast States. I have the honor to say that, as a member of the State board of health, it has recently been my duty to look into and investigate the sanitary condition of the live stock of our State (New Jersey), and in so doing I find that pleuro-pneumonia has and does exist to a more or less degree at the present time; and, so far as we can learn, it has never assumed the epizootic form, while on several occasions it may be said to have presented an enzootic form. But usually, and at the present time, it is found in isolated cases, which may be the means of at any time superinducing an outbreak.

It is always of a contagious character, and entails a mortality of about fifty per cent. of the affected cases, &c., &c.

The preventive measures consist of quarantining, inoculation, and, in radical cases, occision. There have been three special acts enacted by the State legislature for the purpose of arresting its progress on the appearance of an outbreak, the substance of which is conferring power upon township authorities to employ competent medical advice, and, if it should be found necessary, to resort to occision, and the owner to be compensated by the State.

[Inclosure 7 in No. 6.]

Letter from the editor of the American Agriculturist to E. M. Archibald, Esq., Her Britannic Majesty's Consul-General, New York.

JANUARY 21, 1879.

Your inquiriy about diseases of cattle has been referred to me. In reply I beg to say that I know of no disease that is now prevalent among cattle in any part of the country. We have occasionally a few scattered cases of pneumonia occurring in ill-conducted dairies, but it is not of an epizootic character and remains in the stables where it originated. Amongst grazing cattle there is now no disease reported in any part of the country. Our climate fortunately forbids the occurrence of those diseases which prevail in some European countries, and past experience has shown that the cases of pleuro-pneumonia which have occurred at times a few years ago were neither virulent nor difficult to deal with, and that ordinary sanitary precautions now practiced are sufficient to keep it in check. Just now there is none of this existing.

No. 7.

Telegram from Consul-General Archibald to the Marquis of Salisbury.

FEBRUARY 8, 1879.

The cattle disease near Brooklyn, Long Island, is decidedly contagious; pleuro-pneumonia extensively prevalent. There is possibility of contagion affecting Western cattle shipped from this port.

No. 8.

Telegram from Consul-General Archibald to the Marquis of Salisbury.

FEBRUARY 9, 1878.

My telegram yesterday meant extensively prevalent in a large stable near Brooklyn, in which are about 800 cows, and from whence diseased cows are said to have been sent to other parts of Long Island.

No. 9.

Telegram from Foreign Office to Consul-General Archibald.

FEBRUARY 12, 3.50 p. m.

Reference to your telegram of 8th instant. Report by telegram name and owner of stable and address where disease is situated; also the veterinary evidence that it is contagious pleuro-pneumonia. Write full particulars by next post.

No. 10.

Letter from Consul-General Archibald to the Marquis of Salisbury.

JANUARY 30, 1879.

MY LORD: With reference to my dispatch (No. 8) of 21st instant, I have the honor to transmit herewith inclosed, for your Lordship's information, copy of a dispatch, and of its inclosures, received by me from Sir Edward Thornton, communicating the report of an investigation made by the health officer of the District of Columbia, in regard to the real nature of the disease reported to exist among cows in the vicinity of Washington, and referred to in the inclosure of your Lordship's dispatch No. 1, of the 2d instant, from which report it appears that the disease is pleuro-pneumonia.

The author of the observations in the Tribune newspaper, of the 27th November last, on the reported "plague" at Washington, is Dr. James Law, professor of veterinary science in the Cornell University, at Ithaca, in this State, and one whose opinions are well deserving of consideration.

I have not as yet received from the president of the New York College of Veterinary Surgeons his promised report upon this subject.

Referring your Lordship for further information to my dispatch (Consular No. 10) of this date,

I have, &c.,

E. M. ARCHIBALD.

[Inclosure 1 in No. 10.]

Letter from Sir Edward Thornton to E. M. Archibald, Esq., Her Britannic Majesty's Consul-General, New York.

WASHINGTON, *January* 30, 1879.

I have the honor to transmit herewith copy of a note, and of its inclosures, which I have received from Mr. Evarts, from which you will perceive that it is admitted that there have been cases of pleuro-pneumonia, or lung fever, among the cows in the neighborhood of Washington. As it would appear from the Order in Council of the 6th ultimo that the above-mentioned disease is considered to be contagious, I have addressed a further note to Mr. Evarts, inquiring as to the extent of the disease and what steps have been taken to prevent its spreading.

[Inclosure 2 in No. 10.]

Letter from Mr. Evarts to Sir Edward Thornton.

DEPARTMENT OF STATE, *Washington, January* 27, 1879.

SIR: I have the honor to acknowledge the receipt of Mr. Drummond's note of the 16th instant, in which, on behalf of Her Majesty's Government, inquiry is made in reference to the existence among the cows in the vicinity of Washington of a disease similar to the rinderpest, and also as to whether any such or other form of disease has lately prevailed among the cows in or about this city.

In reply, I have to state that the matter has been referred to the Board of Commissioners of the District of Columbia, and that a reply thereto has been received from the president of that body, dated the 24th instant, accompanied by a report on the subject from the health officer of the District, copies of both of which are herewith inclosed for your information.

I have, &c.,

WM. M. EVARTS.

[Inclosure 3 in No. 10.]

Letter from President of the Commissioners, District of Columbia, to Hon W. M. Evarts, inclosing a report from the Medical Officer of Health.

OFFICE OF THE COMMISSIONERS OF THE DISTRICT OF COLUMBIA,
Washington, January 24, 1879.

SIR: In response to your request of the 22d instant, that the Commissioners take measures to ascertain whether the rinderpest or any other form of disease has lately prevailed among the cows in or about the city of Washington, the Commissioners have the honor to say that they referred the matter to the health officer of the District immediately upon the receipt of your communication for investigation, and herewith submit a copy of his report in the premises.

By order of the board.

S. L. PHELPS, *President.*

[Inclosure 4 in No. 10.]

OFFICE OF HEALTH OFFICER, *January* 24, 1879.

Respectfully returned to the Commissioners, District of Columbia, with the following information:

About the 17th of October, 1878, a gentleman residing in the county of Washington, near this city, called at this office and requested the examination of some cattle then ill on his farm. An inspector having considerable experience with diseases of cattle was sent; he made careful and thorough examination of the animals on this and adjoining farms, and reported them suffering from pleuro-pneumonia, or lung fever.

A morning paper in this city made a sensational report of this matter, heading the same "Rinderpest," and from this probably sprung the reports which are said to have appeared in certain New York papers. I have been called upon several times to deny the story, and would again state that careful inspection of the dairy farms in this vicinity has failed to reveal the existence of any disease similar to the rinderpest or cattle plague.

SMITH TOWNSHEND, M. D., *Health Officer.*

Official copy:

WILLIAM TINDALL, *Secretary.*

No. 11.

Letter from United States Minister, London, to the Marquis of Salisbury.

LEGATION OF THE UNITED STATES, LONDON, *February* 19, 1879.

MY LORD: I have the honor to acquaint you that I have just received from Mr. Evarts a circular, of which I inclose copy, and which has been addressed by the Secretary of the Treasury of the United States to collectors of customs and others.

Your lordship will observe that by this document collectors of customs are instructed not to permit shipments of live animals from their respective ports until after an inspection of such animals with reference to their freedom from disease, and the issuance of a certificate showing that they are free from the class of maladies mentioned.

I beg to express the hope that these precautionary measures may have some influence in inducing Her Majesty's Privy Council to rescind or modify their order in relation to this matter of the 10th instant.

I have, &c.,

JOHN WELSH.

[Inclosure in No. 11.]

Copy of a circular in relation to cattle disease, issued by the Secretary of the Treasury February 1, 1879.

[Circular.]

INFORMATION IN REGARD TO CATTLE DISEASE.

TREASURY DEPARTMENT, *Washington, D. C., February* 1, 1879.

By department's circular of December 18, 1878, it was directed that live cattle shipped from the various ports of the United States might be examined with reference to the question whether they were free from contagious diseases, and that if found to be free from such diseases a certificate to that effect should be given. By that circular such inspection was not made compulsory, but the certificate was to be issued only upon the application of parties interested.

As the export trade in live cattle from the United States is of vital importance to large interests, every precaution should be taken to guard against the shipment of diseased animals abroad, and such a guarantee given as will satisfy foreign countries, especially Great Britain, that no risk will ensue from such shipments of communicating contagious or infectious diseases to the animals in foreign countries by shipments from the United States.

Collectors of customs are therefore instructed that in no case will live animals be permitted to be shipped from their respective ports until after an inspection of the animals with reference to their freedom from disease, and the issuance of a certificate showing that they are free from the class of diseases mentioned.

Notice of rejected cattle should be promptly given to this department.

In order that this department may be fully informed in regard to such diseases in any part of the United States, collectors of customs are requested to promptly forward to this department any information which they may be able to obtain of the presence of contagious or infectious diseases prevailing among live animals in their vicinity.

It is probable that if the disease prevails to any considerable extent it will be noticed in the local press, and collectors are requested to send copies of any notices to the department for its information.

JOHN SHERMAN, *Secretary.*

To COLLECTORS OF CUSTOMS AND OTHERS.

No. 12.

Letter from the Clerk of the Council to the Under Secretary of State, Foreign Office.

VETERINARY DEPARTMENT, PRIVY COUNCIL OFFICE,
44 *Parliament Street, Westminster, S. W., February* 27, 1879.

SIR: I have submitted to the lords of the council your letter of the 22d instant transmitting a dispatch, with inclosure, from the United States minister at this court on the subject of the export of cattle from the United States of America to Great Britain.

In reply I am directed to state for the information of Lord Salisbury that the lords of the council have carefully considered the orders given by the American Government for the inspection of cattle previous to exportation. Their lordships are, however, aware from their own experience that no system of inspection at the port, however perfect, affords complete security against the introduction of pleuro-pneumonia. So long, therefore, as that disease exists in the United States, their lordships regret that, looking to the provisions of the contagious diseases animals act, 1878, relative to importation of foreign animals, they are unable to modify the order of the 10th of February, 1879, which prohibits the introduction into Great Britain, except for slaughter, of cattle from the United States of America.

I beg to return the dispatch and inclosure as requested.

I am, &c.,

C. L. PEEL.

No. 13.

Extract from a message from the President of the United States, communicating, in answer to a Senate resolution of 20th February, 1878, information in relation to the disease prevailing among swine and other domestic animals.

EXECUTIVE MANSION, *February* 27, 1878.

To the Senate of the United States:

I transmit herewith, for the information of the Senate, the reply of the Commissioner of Agriculture to a resolution of the Senate of the 20th instant, "relative to the disease prevailing among swine," &c.

R. B. HAYES.

DEPARTMENT OF AGRICULTURE, *Washington, D. C., February* 26, 1878.

SIR: In compliance with a resolution of the Senate, adopted on the 20th instant, calling upon me for such information as may be in my possession relative to the disease prevailing among swine commonly known as "hog cholera," with such suggestions as I may deem pertinent in this connection, I have the honor to herewith transmit a large number of letters from almost every section of the country relating to this and the many diseases to which all other classes of domestic animals are subject. For some years past the local press, and especially the agricultural journals of the country, have been calling attention to the increase of diseases among farm stock, and the consequent heavy losses annually sustained by our farmers and stock breeders and growers.

Our wide extent of country, and its great diversity of temperature and variation of climate, the severity of frosts in some sections, and the intensity of heat in other localities, render farm stock liable to the attacks and ravages of almost every disease known in the history of domestic animals. So general and fatal have many of these maladies grown, that stock breeding and rearing has to some extent become a precarious calling, instead of the profitable business of former years. This would seem to be especially true as it relates to swine. Year by year new diseases, heretofore unknown in our country, make their appearance among this class of farm animals, while older ones become permanently localized, and much more fatal in their results. Farmers, as a general thing, are neglectful of their stock, and pay but little attention to sporadic cases of sickness among their flocks and herds. It is only when diseases become general, and consequently of an epidemic and contagious character, that active measures are taken for the relief of the animals afflicted. It is then generally too late, as remedies have ceased to have their usual beneficial effects, and the disease is only stayed when it has no more victims to prey upon.

BRONCHITIS.

Prof. W. Williams, of the New Veterinary College of Edinburgh, Scotland, has, during the past few years, paid much attention to the study of diseases affecting the air-passages and lungs of domesticated animals. In the second edition of his work, which seems to have been revised with great care, he treats at considerable length of the diseases known as pleuro-pneumonia contagiosa and bronchitis in horned cattle, and points out with distinctness the difference between those diseases. His conclusions are of great importance in the present controversy. In the preface to the second edition of his work, Professor Williams says:

> "The existence and characteristics of pleuro-pneumonia contagiosa and bronchitis in horned cattle were lately the subject of differences of opinion between the veterinary officers of the privy council and the author, in connection with the alleged existence of pleuro among American cattle imported into this country, and slaughtered at Liverpool to prevent contagion. The author has very carefully studied the *post-mortem* appearances of both diseases, and submits his conclusions to the profession. The opportunity of studying the *post-mortem* appearances of bronchitis in its earlier stages but seldom occurs; and had it not been for the slaughter of the cattle referred to, the lesions induced by the initial stages of inflammation of the bronchial tubes could not have been so minutely demonstrated.
>
> "The author does not deny the existence of pleuro in some of the Eastern States of America, but it has not yet been proved that this contagious malady prevails in the Western States, from whence cattle are brought to this country. Of this, however, he is confident, that in none of the diseased lungs of the cattle referred to did he find the characteristics of contagious pleuro; but, in all, those of bronchitis. In this investigation he has received much valuable assistance from Dr. Hamilton, pathologist to the Royal Infirmary, and demonstrator of morbid anatomy in the University of Edinburgh.

BRONCHITIS.

The following is the full text of Professor Williams' article on this subject:

Division.—This disease may, according to its seat, be arranged under four heads, namely, "tracheo-bronchitis," where the lower part of the trachea and larger tubes are the main seat of the inflammation; "bronchitis proper," where the medium-sized bronchi are the chief seats of the disease; "capillary bronchitis," where the smaller bronchi are chiefly implicated; and "catarrhal, lobular, or broncho pneumonia," where the smallest bronchi and alveolar walls are involved in the inflammatory process. For simplicity of description I shall retain the generic term bronchitis, dividing it into acute and chronic.

The character of the inflammation, whatever part of the respiratory tract may be affected, is what is understood as catarrhal—that is, an inflammation in which, instead of an exudation rich in fibrin, there is a fluid secretion containing a large quantity of mucus and cellular elements. In this particular it differs most essentially from inflammation of the lungs, originating in the parenchyma, and from pleuro-pneumonia, in which the pleural surface, as well as the lung structure, is involved. The exudate in these is termed "croupous" or fibrinous.

Causes.—Bronchitis, wherever its seat, is generally due to exposure to cold; it may supervene on an attack of ordinary catarrh, particularly if the animal be neglected, exposed to wet and cold, or kept in ill-ventilated stables. It may also arise without any premonitory catarrhal symptoms in both horses and cattle during voyages by sea, particularly if the weather be rough and stormy, and the animals battened down. During 1877 the author had the opportunity of seeing bronchitis in its purest form, and which proved fatal to many amongst foreign horses imported at Leith. An instructive fact in connection with these cases was that it appeared only after rough and stormy passages; when the weather was fine no cases were observed.

Among cattle shipped to this country from America during the earlier and spring months of 1879, bronchitis was observed almost identical with that seen among the foreign horses already alluded to; as the season advanced, and the weather became warm and less stormy, the disease disappeared.

Bronchitis, like laryngitis, may be caused by the inhalation of irritant matters, and by the accidental entrance of foreign materials, as medicines or food, into the bronchial tubes. Inflammation of the bronchial tubes arising from the latter cause usually occurs in horned cattle, often as a sequel to parturient apoplexy, in which affection the power of deglutition is in a great measure lost, and where the sensibility of the glottis is, during the comatose stage, greatly diminished or entirely absent. In such cases fluid medicines incautiously administered enter the trachea and bronchi, and these may cause immediate death by suffocation, or, if not immediately fatal, induce a severe and perhaps fatal inflammation.

Again, during the state of coma, semi-fluid ingesta are apt to flow into the mouth through the flaccid œsophagus, particularly if the cow lies with its head and anterior extremities lower than the posterior ones. In parturient fever there is also very often during the earlier stages some extent of antiperistaltic action of the œsophagus, with eructations of gases from the rumen; along with such gases semi-fluid ingesta gain entrance into the fauces, and, owing to the paralyzed state of the glottis, fall into the larynx and trachea.

Catarrh or bronchitis, from other than mechanical causes, may, particularly in cattle, if the accompanying cough be long and powerful, cause some degree of vomition. The food thus vomited, or, in other words, coughed up, sometimes gains entrance into the trachea and causes a fatal issue.

Along with Mr. Borthwick, Kirkiston, I saw cases of this kind in a herd of Irish cattle brought to Scotland, and which were suffering from bronchitis and gastric irritation from neglect and exposure. Four of the herd became much worse than the rest, one died, and the other three were slaughtered. In all of them the bronchial tubes were filled with ingesta, ejected into the fauces during violent fits of coughing. Again, in several specimens of the lungs of American cattle slaughtered at Liverpool, supposed to be affected with pleuro-pneumonia, food was found in the bronchi. Is it not possible that during a rough voyage cattle may suffer to some extent from sea-sickness, and even vomition, and that the vomited matters may gain access into the trachea and bronchi? In others of the condemned American cattle the irritation was associated with the presence of filaria in the bronchi. Both the ingesta and the parasites were present only in a minority of the diseased lungs examined, and could therefore be only looked upon as accidental concomitants.

Food sometimes gains access into the trachea in the course of dissolution, or even after death, particularly if the rumen be rather full of moist food; it will then be found in the greatest abundance in the trachea and larger bronchi, whereas in those instances in which it has been in the tubes for some time before death the food will often have disappeared from the larger into the smaller tubes and air cells.

I have witnessed one case of fatal bronchitis in the horse, due to the entrance of vomited ingesta into the bronchi. Some days prior to its death fifteen minims of Fleming's tincture of aconite had been administered; this brought on attempts at vomition and great distress. The animal's respiration continued very highly accelerated after the effects of the aconite had passed off, and continued until the animal died. A *post-mortem* examination revealed the fact that vomition had occurred, and that the small quantity of food thus expelled had entered the larynx and gained access to the bronchi.

ACUTE BRONCHITIS.

Symptoms.—Bronchitis consists of congestion of the bronchial tissues, associated at first with dryness, narrowing, and rigidity, and subsequently moisture, dilatation, and relaxation of the tubes.

Owing to these changes, the vibrating sounds caused by the passage of air through the inflamed bronchi undergo variations, which indicate pretty clearly the dry or moist condition of the parts, or, as some term it, the dry or moist catarrh.

As the symptoms are developed, the cough becomes hoarse, ringing, loud, and paroxysmal; the respirations are in some instances greatly accelerated, indeed out of all proportion to the pulse. For example, the pulse may be seventy or eighty per minute, and the respirations as numerous, or even more so. This indicates bronchitis affecting the smaller tubes and alveolar walls—catarrhal pneumonia—collapse of a more or less extensive area of lung structure, or even occlusion of non-inflamed bronchi and air vesicles by the gravitation into them of the catarrhal fluid, as shown in the wood cut.

Bronchitis of the larger tubes is naturally less dangerous than the other two, and only proves fatal by inducing the two above-mentioned conditions, namely, collapse and occlusion of a more or less extensive breathing surface.

Amongst the foreign horses above alluded to, it was noticed, where the discharge of muco-purulent matter was most profuse, although some of the animals seemed to recover from the febrile disturbance and accelerated breathing of the acute stage, that they succumbed in from fourteen to thirty days afterwards from gangrene of the collapsed lungs, or putrefaction of the fluid incarcerated in the bronchi and air cells; both of these conditions being expressed by fœtor of the breath, exhaustive diarrheas, metastatic inflammations of the articulations and feet, complete loss of appetite, rapid emaciation, fluttering pulse; at first great elevation of temperature—106° F. or more; partial sweats upon the body, gasping respiration, some abdominal pain, and other signs of general septicæmia.

In no case of pure bronchitis is the breathing painful, but short and quick, the thoracic as well as the abdominal muscles being brought into full play; this distinguishes it from the breathing characteristic of pleurisy, in which the ribs are more or less fixed and the respirations abdominal. In ordinary cases of bronchitis the animal is dull, listless, sometimes semi-comatose; hangs its head; is generally thirsty; ropy saliva fills the mouth, which is hot and moist. The visible mucous membranes are infected and present a varying degree of lividity, due to non-oxidation of the blood. The animal stands in a corner or moves listlessly about. If in a box, and the door be open, it stands with its head to the open air, from which it evidently obtains relief. The bowels are generally somewhat constipated, the feces covered with mucus, but they easily respond to purgatives, showing that the alimentary mucous membrane participates in the irritation. The urine is high-colored, scanty, and if examined will be found to contain urea, mucus, and coloring matter in excess, and the chlorides in diminished quantities.

As already stated, bronchitis of the larger tubes is not ordinarily a fatal disease, but when affecting the smaller bronchi and alveoli, particularly if associated with a profuse discharge of a yellowish-colored, more or less tenacious fluid, which occludes the smaller bronchi and air cells, it is the most fatal chest disease that the author is acquainted with. This tendency to gravitation of the catarrhal fluid is explained by the fact that the columnar and ciliated epithelium are shed in the earlier stage of the attack and take no part whatever in the after changes which ensue. It is never seen again till the signs of acute inflammation, such as distension of the vessels and œdema of the basement membrane have passed off. Subsequently it is gradually reproduced. —*Dr. Hamilton.*

The muco-purulent material thus incarcerated is driven or impacted by the ramrod-like action of the inspirated air into the periphery of the smaller tubes and vesicles, and there constitutes those masses which may undergo putrefaction in the horse, causing septicæmia, as already explained, and caseous masses, giving rise to tubercle in the ox.

The physical signs of bronchitis are as follows: Percussion returns a more or less resonant sound, but auscultation will enable the practitioner to detect the nature and extent of the bronchial inflammation. *Rhonchus*, confined to the upper and middle third of the chest, with true respiratory murmur over the lower part, will indicate inflammation of the larger and middle-sized bronchial tubes and a condition of comparatively little danger. *Sibilus*, heard at the lower parts, indicates a condition of much greater danger and that the disease involves the smaller tubes and air vesicles. Inspiration is generally shortened, expiration prolonged and more distinctly accompanied by the abnormal sounds. These sounds are succeeded at a later stage by moist bubbles, rattles, or rales—mucous rales. At first the discharge expelled by coughing is thick, tenacious, and gelatinous, or watery and scant. The lower animals do not, however, expectorate in the true sense of the word; some discharge issues from the nose, but the greater part of what is coughed up falls into the fauces and is swallowed. As the disease advances, however, a profuse discharge issues from the nostrils and the inflammation gradually subsides. The cough becomes less hoarse, more vigorous, and even more frequent than at first, but it gradually disappears; the discharge becomes again thinner, clearer, and eventually ceases.

In some instances all sounds disappear from a certain part of the lungs. This is due to occlusion of the tubes and vesicles by the catarrhal secretion, or to more or less collapse of the vesicular tissue, dependent on obstruction to the passage of air during inspiration by glutinous or inspissated mucus. This collapse is often confined to individual lobules, which are thus condensed, heavy, indurated, and of a dark color, and may ultimately become hepatized, atrophied, or even emphysematous.

PATHOLOGY AND MORBID ANATOMY.

Inflammation of the bronchial tubes, like that affecting other mucous membranes, is attended with changes in their epithelium, the secretion of the glands, and in the surrounding tissues.

It is rare to meet with a fatal case of bronchitis during its earlier stages, and but for the accidental slaughter in Liverpool of the American cattle already referred to, it would have been difficult to have given the details of the morbid anatomy.

The appearance of the lung in the earlier stage of bronchitis, with collapse, that is to say, when it is observed prior to the commencement of secondary changes or pneumonia, is as follows: There are patches over its surface that have fallen below the level of surrounding parts; sometimes these depressions measure an eighth of an inch in depth; they are of a bluish purple color, and variable in size. The parts around them are of a light pink hue, and are either healthy or in a more or less emphysematous condition.

The depressions consist of certain lobules in a state of collapse arising from occlusion of their bronchial tubes by pus or other material. The collapsed portions are bluish-purple in color; non-crepitant and depressed, resembling fetal lungs sinking slowly in water.

Collapse of the lung tissue, atelectasis, induces more or less congestion and subsequent inflammation; consequently it is found that broncho-pneumonia often succeeds bronchitis, due to the absence of the expansion and contraction of the air vesicles which normally aid the pulmonary circulation, and to arrestment of the blood-flow, owing to imperfect aeration. This congestion is soon succeeded by effusion of serum, and the bluish-purple collapsed portions become darker in color and less resistant in consistence. They, however, retain some degree of elasticity, for, if not too rudely pulled out, they do not tear as in pleuro-pneumonia; if cut into and exposed to the atmosphere for a few minutes the bluish-purple color becomes bright scarlet. It is important to bear in mind that the pneumonic process which supervenes in bronchitis is principally confined to those portions of the lungs in which collapse has taken place. Sometimes the collapse is isolated, invading but small portions of the lungs. This condition is not rarely witnessed in parasitic bronchial disease. These limited collapsed portions vary in size, are rather wedge-shaped, and have their apices towards the obstructed bronchus. The lung tissue surrounding them may be more or less congested, or it may be emphysematous, but no juice is exuded from them when cut into, as in acute pleuro-pneumonia.

Professor Gairdner was, I believe, the first to show that condensation of the vesicular substance occurs as a result of mucus or other obstruction in the air-tubes leading to the condensed portion. It is at first sight difficult to understand how incomplete obstructions of the bronchi—and these obtain much more frequently than absolutely complete occlusion—cause collapse. One would suppose that some quantity of air would gain access into the vesicles, but such is apparently not the case; and it seems that the air gradully finds its way out by the edges of the obstructing substance. The expiratory force, so long as there is air in the vesicles, constantly tends to dislodge the obstructing body by pushing it toward the wider (proximal) end of the tube, whilst the inspiratory drives it inwards toward the narrower tubes, which it effectually occludes. The entrance of air is thus more or less effectually opposed and its exit permitted, so that ultimately the vesicles beyond become completely emptied; in fact, the plug acts as a valve, allowing the air to pass in one direction but opposing its passage in the other. Where the obstruction is complete from the commencement the air is absorbed.

It had been supposed by Laennec that the emphysema, or, more correctly, over-distension with air of the parts surrounding the collapsed lobules, was due to what he thought a fact, that the act of inspiration was more powerful than that of expiration; so that though air could be drawn through the obstruction it could not be breathed out. In consequence, it accumulated in the ultimate pulmonary vesicles, became expanded by heat, and so acted mechanically as a dilator. Dr. Gairdner, however, pointed out that expiration is a much more powerful act than inspiration, and that there is never any difficulty in causing expulsion of air, provided always there be no obstruction in the tubes. Emphysema, then, does not occur in the vesicles connected with obstructed tubes, but in those which are adjacent. When the lungs are free from disease the column of air presses equally in all the tubes and vesicles; but when one portion connected with any obstruction is collapsed, then the adjacent parts are over-expanded, so as to occupy the space previously filled by the former.

At a later stage the contents of the obstructed bronchi are pushed by the weight of the descending or inspired atmosphere into the most minute bronchi, alveoli, and air vesicles, always from the center toward the periphery, and appear as minute white points beneath the pleural surface. They are well shown in the figure.

On cutting into the lungs, it will be found that the large and small tubes, and sometimes the trachea, contain an amount of fluid. This condition, as well as the collapse, is limited in the majority of instances to the small or anterior lobes of the lungs, and rarely, except by extension, affects the large lobes, not only in ordinary but in mechanical bronchitis. This fact is of importance, as pleuro pneumonia contagiosa, with which the disease under consideration has been confounded, generally commences in the larger lobes, either in their centers or towards their posterior edges.

The fluid contained in the tubes is thick and has a yellow color; in the trachea it is more or less frothy; and is abundant in the smaller bronchi, as shown in the figure.

If the lungs in this condition be squeezed, little pellets of yellow matter are pressed out. Sometimes these pellets are too small to be seen by the naked eye, and require the aid of a magnifying glass. If the bronchitis be associated with catarrhal pneumonia, elevated patches will be apparent on the cut surface, having a grayish-red color. They are soft to the touch, and if squeezed the same muco-purulent matter exudes from them, or from a small bronchus which may happen to communicate with the particular group of vesicles implicated.

Dr. Hamilton, in his series of papers on bronchitis, published in the *Practitioner* for 1879, states it is a matter of difficulty in man to get at the first change which ensues in the bronchi in acute catarrh. He has, however, been able to verify his observations by an examination along with myself of the lungs of American cattle slaughtered in the earlier stages of bronchitis; in fact, before any external signs of disease were manifested. He says, "On careful comparison, however, of many cases, we feel assured that the first deviation visible is a *relaxation and distension of the abundant plexus of blood-vessels ramifying in the inner fibrous coat*, immediately beneath the basement membrane: that is to say, of the branches of the bronchial artery. They become engorged with blood, so that on transverse section they appear like little cavities distended with blood corpuscles. In a few hours afterward the basement membrane* becomes much more apparent than it usually is, and at the same time more clear and homogeneous, while the surface is thrown into many folds. These changes in the basement membrane are apparently due to its becoming œdematous, serous fluid being infiltrated into it from the underlying plexus of distended vessels; and we shall see that, as the acute irritation continues, this œdematous state of the basement membrane becomes more and more a well-marked feature. The next change, so far as we have been able to calculate, occurs in from twenty to thirty hours after the primary distension of the vessels, and consists in the loosening and desquamation of the columnar epithelium at the foci of greatest congestion.

"The columnar epithelium is thus shed at a very early stage of the attack, and takes no part whatever in the after changes which ensue. It is never seen again until the other signs of acute inflammation, such as the distension of the vessels and œdema of the basement membrane have passed off. Subsequently we shall see that it is gradually reproduced. The cause of this desquamation of the columnar epithelium seems to be the œdema of the basement membrane loosening its underlying attachments, very much in the same way as the vesicles which form in an acute inflammatory affection of the skin loosen the attachments of the superficial layer of epidermis. The removal of this protective covering from the mucous membrane naturally leaves the latter in an exposed condition, and no doubt the feeling of rawness experienced in acute catarrh of the bronchi is due to the cold air acting upon an over-stimulated and exposed mucous membrane. And, further, it can easily be understood that, where this desquamation takes place to an inordinately great extent, the loss of the ciliary action of the columnar cells will seriously interfere with expectoration, and tend to cause the catarrhal products to gravitate downward towards the smaller bronchi and air-vesicles. This description essentially coincides with what Socoloff found experimentally in animals (Virchow's *Archiv.*, vol. 68, p. 611), in which he induced an artificial bronchitis by the injection of irritants, such as potassic bichromate, into the air passages. He states that one of the first changes which ensued was the desquamation of the columnar cells, and that they took no part in the catarrhal inflammatory process." This early shedding of the columnar cells, and their non-reproduction until after the subsidence of the inflammatory process, is a fact of real importance, as it goes a long way to explain the occurrence of those caseous tumors which give rise to tubercle, and are so often confounded with that growth.

The pneumonic process, which may supervene either by extension of the inflammatory process from the tubes to the alveoli or the irritation of inhaled inflammatory products subsequent to collapse, is, in the earlier stage, commonly limited to scattered groups of air-vesicles; hence the term "lobular" which is applied to it. It causes the portions affected to appear as scattered, ill-defined nodules of consolidation, irregular in size, and passing insensibly into the surrounding tissue, which is variously altered by collapse, emphysema, and congestion. These nodules are of a reddish-gray color, faintly granular or smooth, slightly elevated, and soft in consistence. As they increase in size they may become confluent; and in a more advanced stage they become paler, drier, firmer, and to some extent resemble ordinary gray hepatization. Microscopically examined, they are seen to consist of cellular elements accumulated in the alveoli.

The disease may, as already remarked, terminate fatally by the absorption of the putrescent catarrhal products, by gangrene of the collapsed lungs, or by sudden effusion of fluid into the bronchi, constituting what is termed "suffocative catarrh." If a fatal termination does not ensue, the contents of the alveoli undergo degeneration, and are gradually removed by discharge, or by absorption, or by coalescence form caseous masses, which may become encapsuled, undergo the calcareous change, and thus become innocuous; or may induce a diathesis, leading to the actual development of tubercle in the ox and to symptoms simulating phthisis pulmonalis in the horse; that is to say, an accumulation of catarrhal products, epithelial and other cells within the pulmonary alveoli, cellular infiltration and thickening of the walls of the alveoli and bronchi, increase in the interlobular connective tissue, with, in some instances, the occurrence of fibrinous masses intermixed with leucocytes in the alveoli, as demonstrated by Zenker, of Dresden, but without—except very rarely, indeed, in the horse—the occurrence of tubercular tumors (grapes) in the serous membranes and parenchyma of organs.

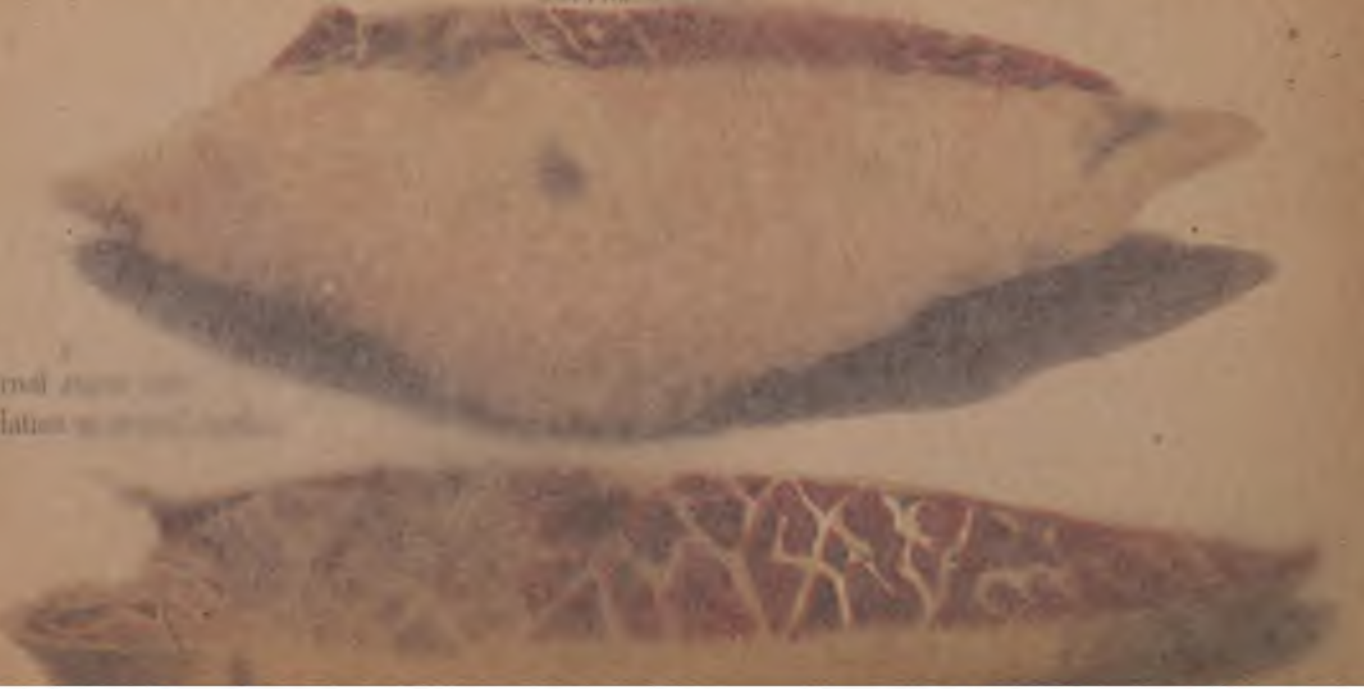
---

* The basement membrane is not so apparent in the lower animals as in man.

Drawings showing comparative appearances of [illegible]

1. [illegible] [illegible]

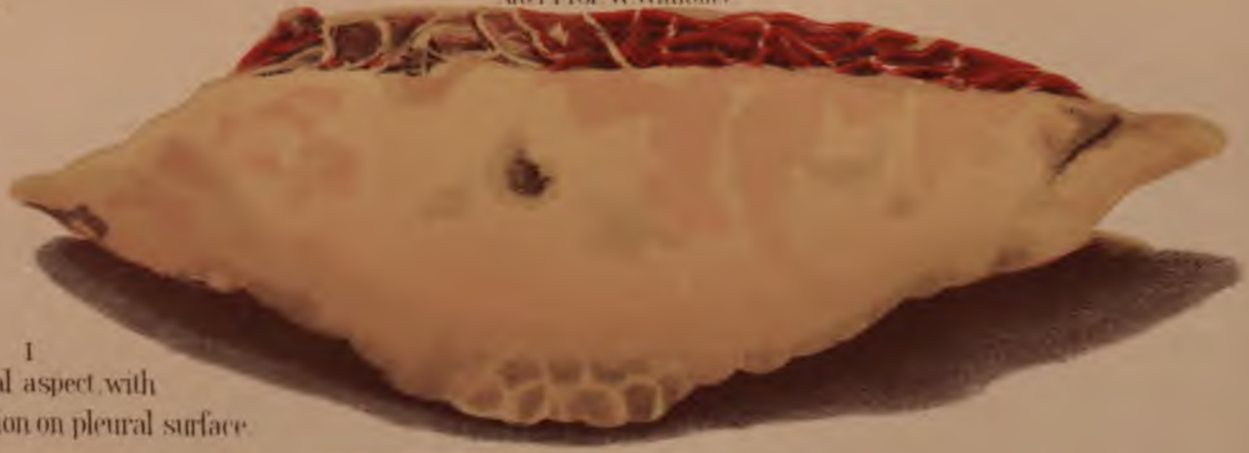
(from Prof. W. [illegible])



Drawings showing comparative appearances of PLEURO-PNEUMONIA CONTAGIOSA AND BRONCHITIS.

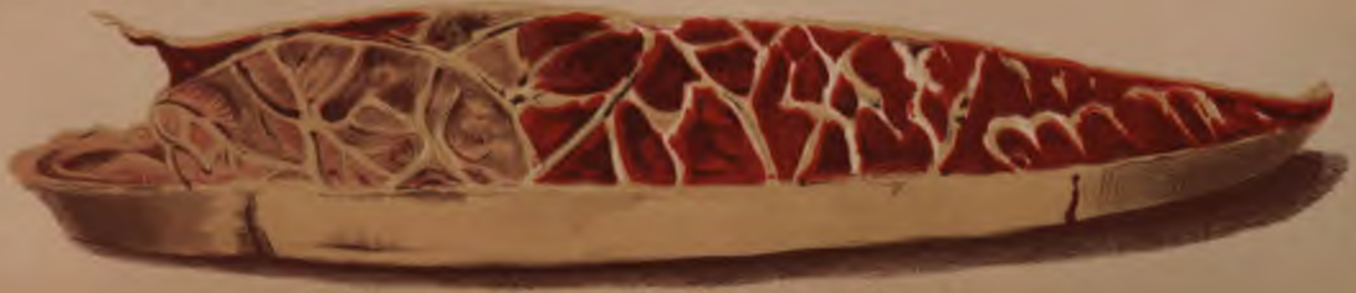
A. PLEURO PNEUMONIA.

After Prof. W. Williams.



I

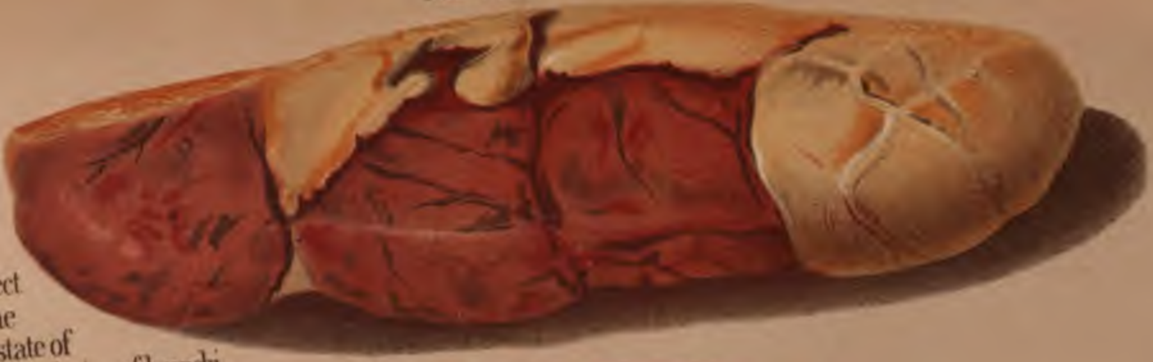
External aspect with exudation on pleural surface.



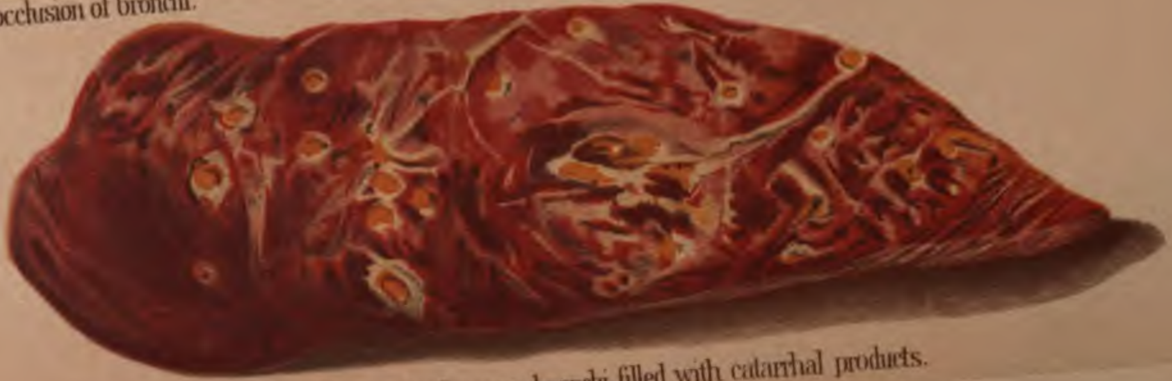
II Internal aspect of same lung showing marbled condition

B. BRONCHITIS. (Earliest Stage).

After Prof. W. Williams.



External aspect
some of the
lobules in a state of
collapse from occlusion of bronchi.



II. Internal aspect of same, bronchi filled with catarrhal products.

Report Commissioner of Agriculture for 1880. Plate III.

CONTAGIOUS PLEURO-PNEUMONIA OF CATTLE.

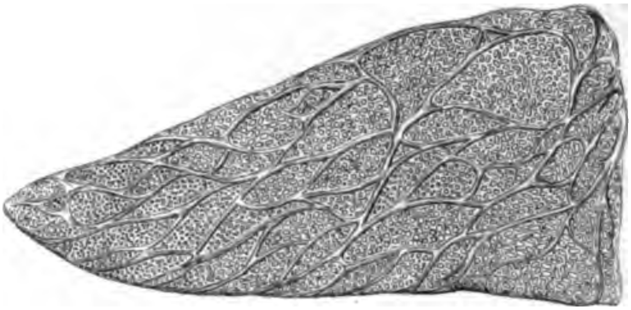


FIG. 3. *Pleural aspect of pulmonary lobe from American ox slaughtered at Liverpool: alveoli filled with muco-purulent matter, pleural surface intact. The microscopic examination revealed broncho-pneumonia in some of the alveoli (see fig. 6), whilst others showed no traces of inflammation (see fig. 1), but were merely filled with the inhaled bronchial secretions.*

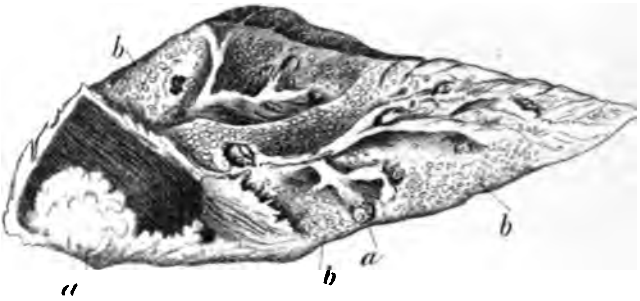


FIG. 4. *Section of portion of lung, the external aspect is shown in fig. 3. The larger (a) and smaller bronchi and air vesicles (b) filled with purulent matter.*

A. Hoen & Co. Lithocaustic Baltimore.

CONTAGIOUS PLEURO-PNEUMONIA OF CATTLE.

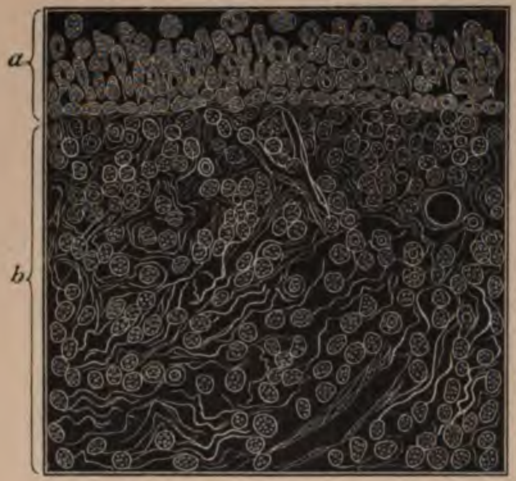


FIG. 5.—*Bronchus (medium sized) in acute bronchitis.—(American ox slaughtered at Liverpool.)*
(a) Deep layer of epithelium, germinating and throwing off catarrhal cells.
(b) Inner fibrous coat, infiltrated with inflammatory cells. (480 diam.) The columnar epithelium shed.

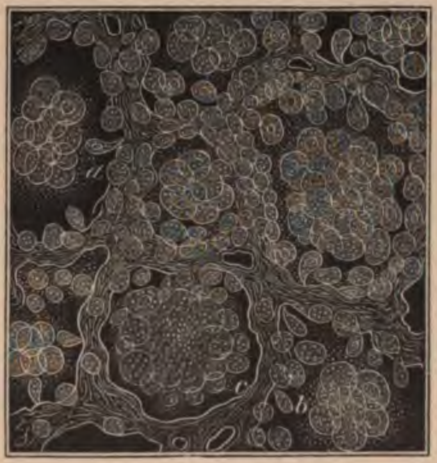


FIG. 6.—*Acute catarrhal pneumonia (American ox).—Section through several air vesicles. Shows the alveolar cavities filled with large granular catarrhal cells (c). (b) Catarrhal cells sprouting from the alveolar wall. (a) Coagulated mucus in which the catarrhal cells lie.—(480 diam.)*

A. Hoen & Co. Lithocaustic Baltimore

CONTAGIOUS PLEURO-PNEUMONIA OF CATTLE.

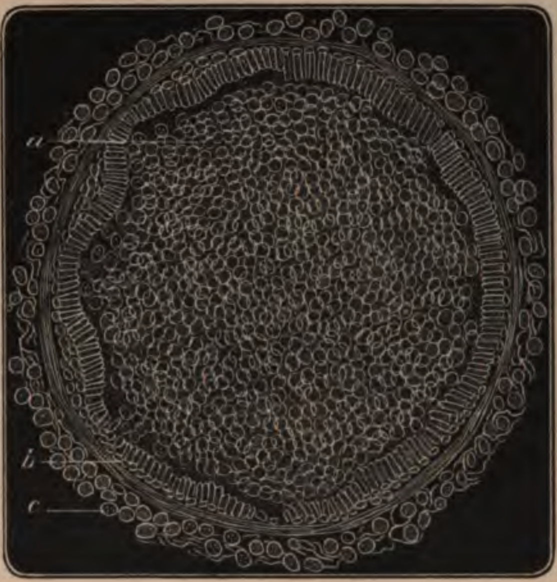


Fig. 1.—*Small bronchus in acute bronchitis, occluded by a plug of catarrhal secretion.—350 diam. a, Catarrhal plug; b, Epithelium lining bronchus; c, Surrounding adventitious coat infiltrated with cells.—(From American ox condemned at Liverpool for pleuro-pneumonia.)*

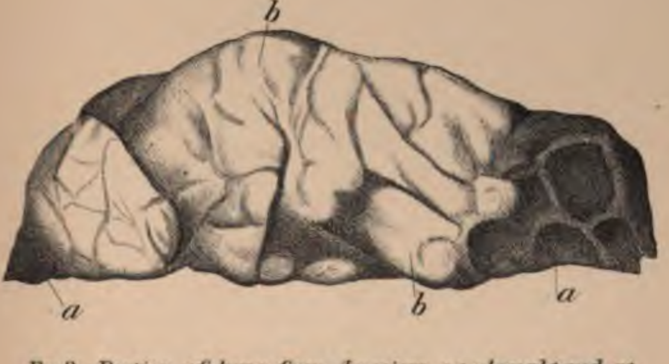


Fig. 2.—*Portion of lung from American ox slaughtered at Liverpool, and showing bronchitis in the very earliest stages (a a, collapsed lobules) from obstruction of tubes. The elevations (b b, non-collapsed lobules) are slightly emphysematous.*

A. Hoen & Co. Lithocaustic Baltimore.

In all cases of bronchitis the bronchial glands undergo some change. In the earlier stages they are increased in size, contain the products of the bronchitis conveyed by the lymph tract, become more or less friable in consistence, and in more advanced bronchial inflammation distended with catarrhal elements, both glands and contents undergoing the caseous metamorphosis, the products of which may either liquefy or become infiltrated with calcareous matter.

THE CONTAGIOUS DISEASES (ANIMALS) ACT, 32 AND 33 VICT., AND ORDERS FOR GREAT BRITAIN.

CHAPTER 70.—An act to consolidate, amend, and make perpetual the acts for preventing the introduction or spreading of contagious diseases among cattle and other animals in Great Britain. [9th August, 1869.]

Whereas it is expedient to confer on Her Majesty's most honorable privy council power to take such measures as may appear from time to time necessary to prevent the introduction into Great Britain of contagious or infectious diseases among cattle, sheep, and other animals, by prohibiting or regulating the importation of foreign animals; and it is further expedient to provide against the spreading of such diseases in Great Britain, and to consolidate and amend and make perpetual the acts relating thereto, and to make such other provisions as are contained in this act:

Be it therefore enacted by the Queen's Most Excellent Majesty, by and with the advice and consent of the lords spiritual and temporal and commons, in this present Parliament assembled, and by the authority of the same, as follows:

PART I.—PRELIMINARY.

1. This act may be cited as the contagious diseases (animals) act, 1869.

2. This act shall not extend to Ireland.

3. This act is divided into parts, as follows:

Part I.—Preliminary.
Part II.—Local authorities.
Part III.—Foreign animals.
Part IV.—Discovery and prevention of diseases.
Part V.—Slaughter in cattle-plague; compensation.
Part VI.—Orders of council and of local authorities.
Part VII.—Lands.
Part VIII.—Expenses of local authorities.
Part IX.—Offenses and legal proceedings.
Part X.—Scotland.

4. The acts described in the first schedule to this act are hereby repealed; but this repeal shall not extend to Ireland, or affect the past operation of any of those acts, or affect any order of Her Majesty in council made, or any order or regulation of the privy council or of a local authority made, or any license granted, or any committee or subcommittee constituted, or any appointment made, or any right, title, obligation or liability accrued, or any rate or mortgage made, or the validity or invalidity of anything done or suffered under any of those acts before the passing of this act; nor shall this repeal interfere with the institution or prosecution of any proceeding in respect of any offense committed against, or any penalty or forfeiture incurred under, any of the acts repealed by this act, or any order or regulation made thereunder, or take away or abridge any protection conferred or secured by any of those acts in relation to anything done thereunder before the passing of this act: and notwithstanding the repeal by this act of any of those acts, every local authority constituted thereby or thereunder shall (subject to any provision of this act altering the local authority or the constitution thereof in any case) continue as if this act had not been passed; and every such order, regulation, license, subcommittee, and appointment, as aforesaid, shall continue and be as if this act had not been passed; but so that the same may be revoked, altered, or otherwise dealt with under this act, as if the same had been made, granted, or constituted under this act.

5. In this act the term "the privy council" means the lords and others of Her Majesty's most honorable privy council.

All or any powers by this act conferred on the privy council may be exercised by those lords and others, or any two or more of them.

Powers by this act conferred on the privy council may, as regards the making of orders affecting only specified ports, towns, or places, or parts thereof, and as regards the issuing and revocation of licenses under any order of council, be exercised by the lord president of the council, or one of Her Majesty's principal secretaries of state.

6. In this act—

The term "cattle" means bulls, cows, oxen, heifers, and calves.

The term "animal" means, except where it is otherwise expressed, cattle, sheep, goats, and swine.

The term "foreign," as applied to cattle or animals, means brought from any place out of the United Kingdom.

The term "cattle-plague" means the rinderpest, or disease commonly called the cattle-plague.

The term "contagious or infectious disease" includes cattle-plague, pleuro-pneumonia, foot-and-mouth disease, sheep-pox, sheep-scab, and glanders,* and any disease which the privy council from time to time by order declares to be a contagious or infectious disease for the purposes of this act.

The term "railway company" includes a company or person working a railway, under lease or otherwise.

The term "person" includes a body corporate or unincorporate.

7. In this act—

The term "borough" means a place which is for the time being subject to the act of the session of the fifth and sixth years of the reign of King William the Fourth (chapter 76), "to provide for the regulation of municipal corporations in England and Wales," or which is a town or place having under any general or local act of Parliament or otherwise a separate police establishment.

The term "county" does not include a county of a city or county of a town, but includes any riding, division, or parts of a county having a separate commission of the peace.

The term "metropolis" includes all parishes and places in which the metropolitan board of works have or had power to levy a main-drainage rate.

For the purposes of this act, the liberty of St. Albans, the liberty of the Isle of Ely, and the soke of Peterborough shall, respectively, be deemed separate counties; but all other liberties and franchises of counties shall be considered as forming part of the county by which they are surrounded; or, if partly surrounded by two or more counties, then as forming part of that county with which they have the longest common boundary.

Every place that is not a borough, a county, or part of the metropolis, as respectively defined in this act, or is not separately mentioned in the second schedule to this act, shall be deemed to form part of a county, as defined in this act, to the county rate whereof it is assessed; or, if it is not so assessed, then of the county within which it is situate.

8. The schedules to this act shall be construed and have effect as part of this act.

PART II.—LOCAL AUTHORITIES.

9. For the purposes of this act, the respective districts, authorities, rates or funds, and officers described in the second schedule to this act shall be the district, the local authority, the local rate, and the clerk of the local authority.

Notwithstanding anything in this act, or the second schedule thereto, within the city of London and the liberties thereof, the mayor, aldermen, and commons of the city of London shall be the local authority, and the town clerk shall be the clerk of the local authority, and the consolidated rate shall be the local rate; but the city of London and the liberties thereof shall nevertheless be deemed part of the metropolis for the purposes of the local rate described in the second schedule to this act in relation to the metropolis.

11. With respect to committees of a local authority, the following provisions shall have effect:

(1.) A local authority shall form a committee or committees, and may delegate to any such committee all or any powers conferred on the local authority by this act, except the power to make a rate.

---

* By an order of council [illegible] dated 30th June, 1873, it was enacted that after the 2d day of July, 1873—

'[illegible] declared to be a contagious disease for the purposes of the act of 1869, and all the provisions [illegible] relating to contagious or infectious diseases contained in any order of council for the time being [illegible] to farcy.

'W[illegible] authorized by the privy council to make regulations for the purpose of preventing the spread of glanders and farcy, or either of them, the local authority may make regulations [illegible]

[illegible] of any field, stable, shed, or other premises in which glanders [illegible] horse [illegible] is, or has been, affected with glanders or farcy [illegible] shed or other premises with or in contact with any [illegible]

A [illegible] August 1874 [illegible] of 1873 [illegible] shall have effect as if [illegible] were substituted for the words contagious and infectious.

The [illegible] in August 1877 recommended that the slaughter of horses affected with glanders [illegible] but that no payment should be made to the owner for the value of the [illegible]

(2.) A local authority may from time to time revoke or alter any power given by them to a committee.

(3.) A local authority may appoint and designate any such committee as their executive committee for the purposes of this act.

(4.) Such an executive committee shall have all the powers of the local authority under this act, except the power to make a rate, and may appoint a subcommittee or subcommittees, and delegate to them all or any powers of the executive committee, with or without conditions or restrictions, and from time to time revoke or alter any such delegation, and fix the quorum, and add to or diminish the number of the members, or otherwise alter the constitution of a subcommittee, and lay down rules for the guidance of a subcommittee, who shall act accordingly.

(5.) Proceedings of a committee or subcommittee shall not be invalidated by any vacancy in the committee or subcommittee, or, in case of a committee appointed by general or quarter sessions of a county, by the termination of the sessions at which they were appointed.

(6.) In case of the formation of two or more committees, they shall act according to rules laid down for their guidance by the local authority.

(7.) The regulations contained in the third schedule to this act shall have effect with respect to the committees and subcommittees.

Inspectors and officers.

12. Every local authority shall from time to time appoint so many inspectors and other officers as appear to the local authority necessary for the execution of this act, and shall assign them such duties and award them such salaries or allowances as the local authority think fit, and may at any time revoke any appointment so made, but so that every local authority shall at all times keep appointed at least one inspector.

13. The privy council, if satisfied on inquiry that an inspector appointed by a local authority is incompetent, or has been guilty of misconduct or neglect in the discharge of his duty, may, if they think fit, direct his removal, and thereupon he shall cease to be an inspector for the purposes of this act.

14. Every local authority, and every inspector appointed by a local authority, shall make such reports to the privy council as the privy council may from time to time require.

PART III.—FOREIGN ANIMALS.

15. The privy council may from time to time by order define the limits of ports for the purpose of this part of this act.

16. The privy council may from time to time by order, in relation to foreign animals, or to any specified kind of foreign animals, or to foreign animals, or any specified kind thereof, brought from any specified country or place, prohibit the landing thereof either generally, or in any specified port, or in any defined part thereof, or elsewhere than in some specified port or ports, or than in some defined part or parts thereof.

This section shall extend to horses and other animals not within the definition of animals in this act.

17. The privy council may from time to time by order apply to the landing, either generally or with specified exceptions, or in some specified port, or in some defined part thereof, of foreign animals, or of any specified kind of foreign animals, or of foreign animals, or any specified kind thereof, brought from any specified country or place, and to the movement and disposal thereof when landed, the regulations contained in the fourth schedule to this act, or any of them.

18. The privy council may from time to time by order, in relation to foreign animals or to any specified kind of foreign animals, or to foreign animals or any specified kind thereof, brought from any specified country or place, add to or vary the regulations contained in the fourth schedule to this act.

19. Where the regulations contained in the fourth schedule to this act, or any of them (with or without addition or variations), are in operation in respect of a port or a defined part thereof, then all animals for the time being within that port or defined part shall, subject to any order of the privy council to the contrary, be deemed foreign animals, and the same regulations shall apply thereto accordingly.

20. The privy council may from time to time by order make such regulations as they think expedient for imposing conditions on the landing of or for subjecting to inspection or to quarantine foreign animals, or any specified kind of foreign animals, or foreign animals or any specified kind thereof, brought from any specified country or place.

This section shall extend to horses and other animals not within the definition of animals in this act.

21. If any person lands or attempts to land any foreign animal (including any horse

or other animal not within the definition of animals in this act) in contravention of any order of the privy council, the animals shall be forfeited in like manner as goods the importation whereof is hereby prohibited by the acts relating to the customs are liable to be forfeited, and the person so offending shall be liable to such penalties as are imposed on persons importing or attempting to import goods the importation whereof is prohibited by the acts relating to the customs, without prejudice to any proceeding against him under this act or any such order, but so that no person be punished twice for the same offense.

Article 9 of order in council (341), dated December 20, 1871, specifies that "animals landed from a vessel shall, on a certificate of an inspector appointed by the privy council in that behalf, certifying to the effect that the foregoing regulations, or some or one of them, have not or has not been observed in the vessel, be detained at the landing-place, or in lairs adjacent thereto, until the privy council otherwise direct."

22. There shall be published in the London Gazette, once in every month, under the direction of the privy council, a return of the number of foreign animals brought by sea to any port in Great Britain, which on inspection on landing within the then last preceding month have been found to be affected with any contagious or infectious disease, specifying the disease and the ports from which and to which such animals are brought, and the mode in which such animals have been disposed of.

23. A local authority may provide, erect, and fit up wharves, lairs, sheds, markets,-houses, and places for the landing, reception, sale, and slaughter of foreign animals.

24. There shall be incorporated with this part of this act the markets and fairs clauses act, 1847; and, for the purposes of the application and construction of that act in conjunction with this part of this act, any place provided by a local authority under this part of this act for the landing, reception, sale, or slaughter of foreign animals, shall be deemed a market, and this part of this act shall be deemed the special act, and the prescribed limits shall be deemed to be the limits of the lands acquired for the purposes of this part of this act; and by-laws shall be approved by the privy council, which approval shall be sufficient without any other approval or any allowance thereof (notice of application for such approval being nevertheless given, and proposed by-laws being published before application for approval, in like manner as under that act notice of application for allowance and publication before that application are required to be made).

25. A local authority may charge for the use of any wharf, lair, shed, market, house, or place provided by them under this part of this act, such sums as they from time to time by by-laws appoint.

26. A local authority, on exercising for the purposes of this part of this act the borrowing powers vested in them under this act, may, if they think fit, give as security for repayment of money borrowed with interest (either together with the local rate, if any, or separately therefrom) the charges which they are authorized to make under this part of this act, and any estates, revenues, or funds belonging to them and not otherwise appropriated by law.

27. All money received by a local authority from charges made by them under this part of this act shall be carried to a separate account, and shall be applied in payment of interest on money borrowed by them for the purposes of this part of this act, and in repayment of the principal thereof, and subject thereto towards discharge of expenses incurred by them in the execution of this act.

1. *By an order in council* (342) *of December* 20, 1871, *additional regulations are laid down with regard to foreign cattle, and which were to take effect from the* **31st** *of that month.*

2. This order may be cited as the foreign animals' order of 1871.

3. This order extends to Great Britain only.

4. In this order—

The act of 1869 means the contagious diseases' (animals) act, 1869.

A defined part of a port means a part of a port defined by a special order of the privy council in pursuance of regulations 2 of the fourth schedule to the act of 1869.

Landing-place for slaughter means a landing-place within a defined part of a port.

Master includes any person having the charge or command of a vessel.

Other terms, except when otherwise expressed, have the same meaning as in the act of 1869.

5. Foreign animals shall not be landed at any place except the ports comprised in the first schedule in this order.

6. Foreign animals landed at any port shall be landed in such manner, within such times, and subject to such supervision and control as the commissioners of Her Majesty's customs from time to time direct, and when landed shall be placed under the charge of a veterinary inspector appointed in that behalf by the privy council, and shall be dealt with in accordance with the instructions from time to time given by the privy council.

7. Foreign animals shall, except as in this order provided, be detained for at least twelve hours after landing in some lair or other proper place adjacent to the landing-place, and shall be inspected by the veterinary inspector of the privy council.

8. Where one part of a cargo of foreign animals is landed at one place and another part is landed at another place, or where parts of a cargo of foreign animals are landed at different times at the same place, twelve hours' detention shall commence from the time of the landing of the last animal of the cargo; and if any contagious or infectious disease is detected in any animal of the cargo, every animal in each separate part of the cargo shall be dealt with as if the disease had been detected in an animal in each separate part.

9 Where any foreign animal forming part of one cargo has not been kept separate from any foreign animal forming part of another cargo, all the foreign animals forming such cargoes shall be treated as forming one cargo.

10. A veterinary inspector of the privy council may detain, for any period that he thinks necessary or proper, any foreign animals (including horses and other animals not within the definition of animals in the act of 1869) which he has reason to suspect are affected with any contagious or infectious disease, or may introduce any such disease.

11. If any foreign sheep or swine are found to be affected with any contagious or infectious disease (except cattle-plague) such sheep or swine shall be kept separate from those of the same cargo not found to be so affected; and the slaughter of those not found to be so affected may, with the permission of the veterinary inspector of the privy council, be begun at any time before the expiration of the twelve hours' detention, and be continued without intermission.

12. No animal, carcass, hide, meat, or offal, and no hay, straw, litter, or other things commonly used for food of animals, or otherwise for or about animals, and no dung shall be removed from their lair or other place adjacent to the landing place where foreign animals are detained, except with the permission of the veterinary inspector of the privy council, and, if the inspector is of opinion that any such animal or thing as aforesaid may introduce any contagious or infectious disease, the same shall be slaughtered, destroyed, or otherwise dealt with in accordance with the instructions from time to time given by the privy council.

13. Subject to any provision in this or any other order to the contrary, all the regulations in the fourth schedule to the act of 1869 shall apply to cattle brought from any port or any of the countries comprised in the second schedule to this order; and, subject as aforesaid, all such cattle shall be slaughtered within ten days after the landing thereof, exclusive of the day of landing.

14. The landing of foreign cattle elsewhere than at a landing-place for slaughter shall be subject to the following conditions:

First. That the vessel in which they are imported has not, within three months before taking them on board, had on board any cattle exported from any port of any of the countries comprised in the second schedule to this order.

Secondly. That the vessel has not, since taking on board the cattle imported, entered any port of any of those countries.

Thirdly. That the cattle imported have not, while on board the vessel, been in contact with any cattle exported from any port of any of those countries.

And foreign cattle shall not be landed elsewhere than at a landing-place for slaughter, unless and until—

(1.) The owner or charterer of the vessel in which they are imported, or his agent in Great Britain, has entered into a bond to Her Majesty the Queen, in a sum not exceeding one thousand pounds, with or without a surety or sureties, to the satisfaction of the commissioners of Her Majesty's customs, conditioned for the observance of the foregoing conditions in relation to cattle to be landed under this order from the vessel; and

(2.) The master of the vessel has on each occasion of importation of cattle therein satisfied the commissioners of Her Majesty's customs or their proper officer, by declaration made and signed or otherwise, that none of the cattle then imported therein have been exported from any port of any of the countries comprised in the second schedule to this order, and that the foregoing conditions have been observed in relation to all the cattle then imported therein.

15. Foreign animals landed from a vessel elsewhere than at a landing-place for slaughter shall not be moved therefrom or be allowed to come in contact with any other animals until they have been examined by the veterinary inspector appointed in that behalf by the privy council, and according to the result of such inspection the following consequences shall ensue:

(1.) If the inspector certifies that all the animals landed from the vessel are free from contagious or infectious disease, they shall thereupon cease to be deemed foreign animals.

(2.) If the inspector certifies, with respect to any one or more of the animals landed from the vessel, that it or they is or are affected with any contagious or infectious disease, all the animals then imported in the vessel shall be slaughtered or otherwise dealt with in accordance with the instructions from time to time given by the privy council.

16. The regulations of the fourth schedule to the act of 1869 shall not apply to

any milch cow brought from a port of any of the countries comprised in the second schedule to this order, provided the commissioners of Her Majesty's customs are, on each occasion of the same being so brought, satisfied that the same had been taken from Great Britain to that port, and has not been landed at that port or at any other port of any of those countries; and in relation to the landing, on any occasion, of any such milch cow in Great Britain elsewhere than at a landing place for slaughter, the condition that the vessel has not, since taking on board the cattle imported, entered any port of any of those countries, shall not operate provided the commissioners of Her Majesty's customs are on each occasion satisfied as aforesaid; and the twelve hours' detention may be enforced on board the vessel.

17. In the case of a foreign animal which is brought in a vessel from any country other than those comprised in the second schedule to this order, but which was not taken on board for importation into Great Britain, the twelve hours' detention may be enforced on board the vessel.

18. If a vessel arriving at a port has on board the carcass of a foreign animal (including a horse) which was taken on board for the purpose of importation, but has died on the voyage, the master of the vessel shall, immediately on arrival, report the fact to the principal officer of Her Majesty's customs at the port.

No such carcass shall be landed or discharged from the vessel without the permission in writing of the principal officer.

19. Where it appears to the principal officer of Her Majesty's customs at a port, with respect to any foreign animal (including a horse or other animal not within the definition of animals in the act of 1869), or any hay, straw, fodder, or other article, brought by sea to the port, that contagion or infection may be thereby conveyed to animals, he may seize and detain the same, and he shall forthwith report the facts to the commissioners of Her Majesty's customs, who may give such directions as they think fit, either for the slaughter or destruction or the further detention thereof, or for the restoration thereof to the owner on such conditions, if any (including payment by the owner of expenses incurred by them in respect of detention thereof), as they think fit.

20. Foreign cattle, sheep, goats, and swine, in a defined part of a port (except sheep, goats, and swine in a defined part of the port of London) shall be marked as follows:

Cattle.—By clipping a broad arrow, about five inches long, on the left quarter (in addition to clipping the hair off the end of the tail, as prescribed by regulation 4 of the fourth schedule to the act of 1869).

Sheep and goats.—By clipping a broad arrow, about four inches long, on the forehead.

Swine.—By printing a broad arrow, about three inches long, on the left side with the following composition, namely: Rosin, five parts; oil of turpentine, two parts; and red ocher, one part; melted and use warm.

21. Where any regulation relating to foreign animals is in operation, the local authority and all constables and police officers shall assist the veterinary inspector of the privy council to carry the same into effect and to enforce the same, and shall do or cause to be done all things from time to time necessary for the effectual execution of the same.

22. A person for the time being appointed by the privy council an inspector, for the purposes of the act of 1869, shall have at every port all such powers, authorities, and privileges as a veterinary inspector specially appointed by the privy council for the inspection of foreign animals has at any specified port.

23. In paragraph 5 of the fourth schedule to the act of 1869, the words privy council shall be deemed to be substituted for the words commissioners of customs.

24. For the explanation and amendment of certain orders of council having a local operation only, the following provisions shall have effect:

(1.) Any defined part of a port for cattle shall be deemed a defined part of the same port for animals.

(2.) In the order of the 1st day of October, 1870, defining parts of the port of Southampton, the words, "the veterinary inspector appointed in that behalf by the privy council" shall be deemed to be substituted for the words "an officer of customs."

In an order in council, of August 7, 1864, cited as the "animals (amendment) order of 1874," the words of which were to have the same meaning as in the act of 1869, it is stated that (3) the foreign animals order of 1871 "has and shall have effect subject and by way of supplement to the animals order of 1871; and nothing in the foreign animals order of 1871 interferes or shall interfere with the execution or discharge by the local authority, or the inspector or other officer of the local authority, of any power or duty conferred or imposed on them or him by the act of 1869, or by any order of council." It also states that (4) "Regulation 7 of the fourth schedule to the act of 1869, shall apply in every case where a vessel comes into port having on board foreign animals maimed or injured on the voyage; but notwithstanding anything in section nineteen of the act of 1869, any animals being at any time within such port shall not be deemed foreign animals by reason only of anything in this order."

An order in council (351) further regulates the importation of cattle from Russia. It is dated July 19, 1872, and specifies—

1. This order shall take effect from and immediately after the nineteenth day of July, one thousand eight hundred and seventy-two; and words in this order have the same meaning as in the act of 1869.

2. Cattle brought from any place in the dominions of the Emperor of Russia shall not be landed at any port or place in Great Britain.

3. The following articles brought from any place in the dominions of the Emperor of Russia shall not be landed at any port or place in Great Britain: Manure or hay.

4. The following articles brought from any place in the dominions of the Emperor of Russia shall not be landed at any port or place in Great Britain except at the ports at which foreign animals may be landed, and shall not be removed from the place where landed without a certificate of an inspector of the privy council, certifying that such articles are not likely to introduce any contagious or infectious disease: Meat, hides, fat, hoofs, or horns.

5. Subject to the provisions contained in the orders of council relating to the ports of Granton and Leith, dated the tenth day of August, one thousand eight hundred and sixty-nine, and in the order of council relating to the port of Southampton, dated the first day of October, one thousand eight hundred and seventy, all the regulations in the fourth schedule to the act of 1869 shall apply to sheep and goats brought to Great Britain from any place in the dominions of the Emperor of Russia, and landed in Great Britain, and all such sheep and goats shall be slaughtered within ten days after the landing thereof, exclusive of the day of landing; provided, nevertheless, that cattle, sheep or goats being or having been on board any vessel at the same time with any cattle brought from any place in the dominions of the Emperor of Russia shall not be landed at any port or place in Great Britain.

6. Notwithstanding any order of council to the contrary, no sheep or goats brought from any place in the dominions of the Emperor of Russia, and landed within the port of London shall be moved alive out of any part of the port defined as a part within which foreign cattle may be landed for slaughter.

An order of council (364) dated July 11, 1873, regulates the tariff in cattle with Schleswig-Holstein. It says:

1. This order shall take effect from and immediately after the twenty-third day of June, one thousand eight hundred and seventy-three, and shall cease to have effect from and immediately after the thirtieth day of November, one thousand eight hundred and seventy-three.

2. The order may be cited as the Schleswig-Holstein order of 1873.

3. This order extends to Great Britain only.

4. In this order—

The act of 1869 means the contagious diseases (animals) act, 1869.

A defined part of a port means a part of a port defined by a special order of the privy council in pursuance of regulation 2 of the fourth schedule to the act of 1869.

Landing place for slaughter means a landing place within a defined part of a port.

Master includes any person having the charge or command of a vessel.

Other terms have the same meaning as in the act of 1869.

5. Notwithstanding anything in the foreign animals order of 1871, the regulations in the fourth schedule to the act of 1869 shall not apply to cattle brought from a port in either of the parts of the Empire of Germany respectively known as Schleswig and Holstein.

6. Cattle brought from a port of Schleswig or of Holstein shall not be landed elsewhere than at a landing-place for slaughter, unless and until the owner, agent, or charterer of the vessel in which they are brought has received the special permission of the privy council to employ the vessel in the trade of importation of cattle from ports of Schleswig and of Holstein, or of either of them, under this order.

7. The landing of cattle brought from a port of Schleswig or of Holstein, elsewhere than at a landing-place for slaughter, shall be subject to the following conditions:

First. That the vessel in which they are imported has not, within three months before taking them on board, had on board any cattle exported from any port in any part of the Empire of Germany, other than Schleswig or Holstein, or from any port of any of the following countries, namely: The dominions of the Emperor of Russia, the Austrian-Hungarian Empire, the dominions of the Sultan, the dominions of the King of Italy, the dominions of the King of the Hellenes, Belgium, France.

Secondly. That the vessel has not, since taking on board the cattle imported, entered any such port as aforsaid.

Thirdly. That the cattle imported have not, while on board the vessel, been in contact with any cattle exported from any such port as aforesaid.

Fourthly. That the cattle imported are accompanied by a declaration and certificates, such as are indited in the forms set forth in the schedule to this order, or to the like effect.

8. Further, cattle brought from a port of Schleswig or of Holstein shall not be landed elsewhere than at a landing-place for slaughter, unless and until—

(1.) The owner or charterer of the vessel in which they are imported, or his agent in Great Britain, has entered into a bond to Her Majesty the Queen, in a sum not exceeding one thousand pounds with or without a surety or sureties to the satisfaction of the commissioners of Her Majesty's customs, conditioned for the observance of the foregoing conditions in relation to cattle to be landed under this order from the vessels; and

(2.) The master of the vessel has on each occasion of importation of cattle therein satisfied the commissioners of Her Majesty's customs, or their proper officer, by declaration made and signed or otherwise, that none of the cattle then imported therein have been exported from any port in any part of the Empire of Germany, other than Schleswig or Holstein, or from any port of any of the other countries named in article 7 of this order, and that the foregoing conditions have been observed in relation to all the cattle then imported therein.

9. If the veterinary inspector of the privy council is of opinion, on the examination of any cattle imported under this order, that the declaration accompanying the cattle is untrue in any particular as regards any one of the cattle in the vessel, then all the animals in the vessel shall be detained and dealt with in accordance with instructions from time to time given by the privy council.

10. If the declaration accompanying any cattle imported under this order is untrue in any particular as regards any one of the cattle to which it relates, the master of the vessel shall be guilty of an offense against this order, unless he shows to the satisfaction of the justices before whom he is charged that he did not know of the same being so untrue, and that he could not with reasonable diligence have obtained such knowledge.

11. Subjects to the provisions of this order all the provisions of the foreign animals order of 1871 shall continue to apply to cattle brought from a port of Schleswig or of Holstein.

SCHEDULE.

Declaration and certificates.

DECLARATION.

I, *A. B.*, of———, being the agent for the owners [or charterers] of the vessel———, of———, hereby solemnly and sincerely declare to the best of my knowledge and belief that each of the cattle described below, now about to be put on board the said vessel, has been bred and fed exclusively in Denmark, Schleswig, and Holstein, or some or one of them, and has never been in contact with cattle not so exclusively bred and fed.

Dated this——day of———.

(To be signed.) A. B.

Description of cattle above referred to:

	*Number.
Bulls	
Oxen	
Cows	
Calves	

CERTIFICATE BY CONSULAR OFFICE.

I, C. D., vice-consul [*or as the case may be*] of Her Britannic Majesty at the port of Husum [*or as the case may be*], hereby certify that the foregoing declaration was made by the above-named A. B. before me, this——day of———, 1873, and that I know the said A. B., and that he is worthy of belief.

(To be signed.) C. D.

[and consular seal to be affixed.]

CERTIFICATE OF OFFICER OF ROYAL PRUSSIAN PROVINCIAL COUNCIL OFFICE.

I, X. Y., hereby certify that I have this day seen the cattle above described, and that I believe the statement respecting the breeding and feeding of each of them contained in the foregoing declaration of A. B. to be true in all respects.

(To be signed.) X. Y.

Office of royal Prussian provincial council at the port of Husum [*or as the case may be*].

---

*Number to be expressed in words and figures.

28. With respect to the metropolis, notwithstanding anything in this act or in the second schedule thereto, the following provisions shall have effect:

(1.) The mayor, aldermen, and commons of the city of London shall, for the purposes of this part of this act, be exclusively the local authority in and for the metropolis.

(2.) The Mayor, aldermen, and commons, on exercising for the purposes of this part of this act the borrowing powers vested in a local authority under this act, may borrow on the credit of the property on the credit whereof they are authorized to borrow by the metropolitan market act, 1865, and the money so borrowed may be secured in the manner and subject and according to the provisions in that act authorized and contained.

(3.) All money received by the mayor, aldermen, and commons from charges made by them under this part of this act shall (subject to the application thereof as in this part of this act directed in payment of interest on and in repayment of principal of money borrowed for the purposes of this part of this act) be applied in repayment of the principal of money borrowed by them under the metropolitan market acts, 1857 and 1865, and subject thereto in discharge of expenses incurred by them in the execution of this part of this act.

(4.) From and after the opening for public use of a market provided by the mayor, aldermen, and commons under this part of this act to the satisfaction of the privy council (declared by order), the maximum tolls, dues, and payments that may be taken under the metropolitan market act, 1857, in respect of the animals mentioned in the fifth schedule to this act, shall be the sums in that schedule specified in lieu of those specified in schedule A to that act.

29. Provided that if the mayor, aldermen, and commons of the city of London do not before the first day of January, one thousand eight hundred and seventy-two, provide and open for public use a market for the purposes of this part of this act to the satisfaction of the privy council (declared by order), then on and after that day the following consequences shall ensue:

(1.) The provision of this part of this act making the mayor, aldermen, and commons exclusively for the purposes of this part of this act the local authority in and for the metropolis shall cease to operate.

(2.) The enactment in section 15 of the metropolitan market act, 1857, that no new market for the sale of cattle or horses shall be opened in the cities of London or Westminster, or the liberties thereof, or in the borough of Southwark, or at any place distant less than seven miles in a straight line from St. Paul's Cathedral, in the city of London, shall not prevent any local authority or person from establishing a market for the purposes of this part of this act in or at any place named or defined in that section.

30. Where a local authority, with the approval of the privy council, have, before or after the passing of this act, provided, erected, and fitted up within a part of a port defined by the privy council as a place where foreign animals may be landed any wharf, lair, shed, market, house, or place for the landing, reception, sale, or slaughter of foreign animals, it shall not be lawful for the privy council (as long as importation of foreign animals for that port is allowed, but under restriction) to revoke the definition of the part or parts of that port at which foreign animals may be landed, or to alter it so as to exclude therefrom any part of the site of such wharf, lair, shed, market, house, or place, except with the consent of the local authority; and if any railway company have provided, erected, or fitted up any such wharves, lairs, sheds, markets, houses, or places, the same may, with the approval of the privy council, be used for the purposes of this part of this act.

(By an order in council (341) of December 20, 1871, the restrictions imposed by the metropolitan contagious diseases (animals) order of August, 1869, were revoked after December 31st of that year.)

PART IV.—DISCOVERY AND PREVENTION OF DISEASE.

31. An inspector of a local authority, on receiving information of the supposed existence of cattle-plague, pleuro-pneumonia, or sheep-pox, or having reasonable ground to suspect that any of those diseases existed in any place within his district, shall proceed to that place with all practical speed, and execute and discharge the powers and duties by or under this act conferred and imposed on him as inspector.

32. An inspector or other officer of a local authority, authorized to act in the execution of this act, may at any time enter any field, stable, cow-shed, or other premises within his district where he has reasonable grounds for supposing that any animal affected with cattle-plague, pleuro-pneumonia, or sheep-pox is to be found, for the purpose of executing this act, but shall, if required, state in writing the grounds on which he has so entered.

If any person refuses admission to such inspector or officer acting under this section, he shall be deemed guilty of an offense against this act.

33. The certificate of an inspector of a local authority to the effect that an animal within his district is affected with cattle-plague, pleuro-pneumonia, or sheep-pox shall for the purposes of this act be conclusive evidence in all courts of justice and elsewhere of the matter certified.

Infected places: cattle-plague and sheep-pox.

34. Where an inspector finds cattle-plague or sheep-pox to exist within his district, he shall forthwith make a declaration thereof under his hand, and shall deliver a notice under his hand of such declaration to the occupier of the field, stable, cow-shed, or other premises where the disease is found, and thereupon the same, with all lands and buildings contiguous thereto in the same occupation, shall become and be an infected place, and the same shall continue to be an infected place until the determination and declaration of the local authority relative thereto in this act provided for.

35. Where an inspector makes such a declaration of the existence of cattle-plague or sheep-pox, he shall with all practicable speed send a copy thereof to the privy council, and deliver the declaration to the local authority, who shall forthwith inquire into the correctness thereof, and if it appears to them that cattle-plague or sheep-pox existed as declared by the inspector, they shall so determine and declare, and shall prescribe the limits of the infected place; but if it appears to them that cattle-plague or sheep, pox did not exist as declared by the inspector, and the same is certified to them in writing by one or more duly qualified veterinary surgeon or surgeons, employed by them in that behalf, they shall so determine and declare, and thereupon the place comprised in the inspector's declaration, or affected thereby, shall cease to be an infected place.

36. A local authority, with respect to any place within their district, and the privy council, with respect to any place in Great Britain, may from time to time by order declare any field, stable, cow-shed, or other premises in which cattle-plague or sheep-pox exists at the date of the order, or has existed within seven days before that date, with or without a further area, to be from and after a time specified in the order an infected place.

37. The area of an infected place may in all cases of a declaration by a local authority include, with the field, stable, cow-shed, or other premises in which cattle-plague or sheep-pox has been found to exist, all lands and buildings lying contiguous thereto, being in the same occupation, and within the district of the local authority, and also (except in the metropolis) an area comprised within one mile from the boundaries of those lands in every direction, but no more.

38. A local authority may include in the area of an infected place any adjoining part of the district of another local authority, with the previous consent of that authority in writing signed by their clerk, but not otherwise.

39. The area of an infected place may in all cases of a declaration by the privy council include, with the field, stable, cow-shed, or other premises in which cattle-plague or sheep-pox has been found to exist, such an area as to the privy council seems to be requisite.

40. With respect to the metropolis, the privy council may from time to time, by order, extend the limits of an infected place beyond the boundaries of the field, stable, cow-shed, farm, or premsies where cattle-plague or sheep-pox is declared or found to exist.

41. The area of an infected place may in any case be described by reference to a map deposited at some specified place, or by reference to townships, parishes, farms, or otherwise.

42. An order of a local authority declaring a place to be an infected place shall be published by the local authority by notices posted in and near the infected place, and in such other manner (if any) as they think expedient.

An order of the privy council declaring a place to be an infected place shall be published in like manner by and at the expense of any local authority to whom the same is sent by the privy council for publication.

Any want of or defect or irregularity in publication shall not invalidate any order.

43. An order of a local authority or of the privy council declaring a place to be an infected place shall be conclusive evidence in all courts of justice and elsewhere of the existence of disease and other matters on which the order proceeds.

44. The rules set forth in the sixth schedule to this act shall have effect with respect to infected places (which rules are in this act referred to as the rules of this act with respect to infected places).

45. If any animal, hide, skin, hair, wool, horn, hoof, offal, carcass, meat, dung, hay, straw, litter, or other thing is moved in contravention of the rules of this act with respect to infected places, every person moving the same or causing the same to be moved shall be deemed guilty of an offense against this act.

46. The rules of this act with respect to infected places shall not restrict the moving of any animal or thing by railway through an infected place, such animal or thing not being stopped within the infected place.

47. The privy council may from time to time by order make rules with respect to infected places, not being inconsistent with the rules set forth in the sixth schedule to this act; and with respect to the metropolis the privy council may also from time to time, if they think it expedient, vary the rules set forth in that schedule; and all rules and variations of rules so made shall be deemed rules of this act with respect to infected places.

48. Every local authority and the police of every county, borough, town, and place shall, within their respective districts, enforce and execute the provisions of this act and of any order of the local authority or privy council thereunder relative to infected places, and do or cause to be done all things from time to time necessary or expedient for securing as far as may be the effectual isolation of infected places in respect of the movement of animals and things.

49. Any constable may proceed as follows:

(1.) He may apprehend any person found committing an offense against the rules of this act with respect to infected places, and he shall take any person so apprehended, as soon as conveniently may be, before a justice of the peace, to be examined and dealt with according to law; and a person so apprehended shall not be detained in custody by any constable without the order of a justice longer than is necessary for bringing him before a justice, or than twenty-four hours at longest.

(2.) He may require that any animal or thing moved out of an infected place in contravention of those rules be forthwith taken back within the limits of that place, and may enforce and execute such requisition.

50. The local authority by whom an infected place is declared may at any time after the expiration of twenty-eight days from the disappearance of cattle-plague or sheep-pox (as the case may be) in that place, by order declare the place to be free from cattle-plague or sheep-pox (as the case may be).

The privy council may at any time by order declare any place to be free from cattle-plague or sheep pox.

Thereupon, as from the time specified in this behalf in the order of the local authority or privy council, the place shall cease to be an infected place as regards cattle-plague or sheep-pox (as the case may be).

51. The clerk of a local authority declaring a place to be an infected place, or declaring a place to be free from cattle-plague or sheep-pox, shall forthwith report by post to the privy council the fact of such declaration having been made.

52. An order of the privy council relative to an infected place shall supersede any order of a local authority inconsistent with it.

53. Where, under this act, an inspector makes a declaration which constitutes a place an infected place, he may also, if the circumstances of the case appear to him so to require, deliver a notice under his hand of such declaration to the occupiers of all lands and buildings adjoining thereto, any part whereof respectively lies within one mile of the boundaries of the infected place in any direction, and thereupon the rules of this act with respect to infected places shall, until the determination and declaration of the local authority relative thereto in this act provided for, apply and have effect to and in respect of those lands and buildings as if the same were actually within the limits of the infected place.

Pleuro-pneumonia.

54. Where an inspector finds pleuro-pneumonia to exist within his district, he shall forthwith make a declaration thereof under his hand, and shall deliver a notice under his hand of such declaration to the occupier of the field, stable, cow-shed, or other premises where the disease is found; and thereupon the rules set forth in the seventh schedule to this act (in this act called the pleuro-pneumonia rules of this act) shall have effect in relation to such field, stable, cow-shed, or other premises, until the determination and declaration of the local authority relative thereto in this act provided for.

55. Where an inspector makes a declaration of the existence of pleuro-pneumonia, he shall with all practicable speed send a copy thereof to the privy council, and deliver the declaration to the local authority, who shall inquire into the correctness thereof; and if it appears to them that pleuro-pneumonia existed as declared by the inspector, they shall so determine and declare, and thereupon the pleuro-pneumonia rules of this act shall continue to apply to the field, stable, cow-shed, or other premises to which the declaration relates; but if in any such case it appears to the local authority that pleuro-pneumonia did not exist as declared by the inspector, or that a fresh case of pleuro-pneumonia has not occurred for thirty days in such field, stable, cow-shed, or other premises, then the local authority shall so determine and declare, and the pleuro-pneumonia rules of this act shall cease to operate in relation thereto.

Miscellaneous.

56. The forms given in the eighth schedule to this act, with such variations as circumstances require, may be used by an inspector for the purposes of this part of this

act, and a declaration of disease under this part of this act shall not be deemed a certificate of the inspector for any purpose of this act.

57. If any person exposes in a market or fair or other public place where horses or animals are commonly exposed for sale, or exposes for sale in any sale-yard, whether public or private, or places in a lair or other place adjacent to or connected with a market or fair, or where horses or animals are commonly placed before exposure for sale, or sends or causes to be carried on a railway or on a canal, river, or other inland navigation, or on a coasting vessel, or carries, leads, or drives, or causes to be carried, led, or driven on a highway or thoroughfare any horse or animal affected with a contagious or infectious disease, he shall be deemed guilty of an offense against this act, unless he shows to the satisfaction of the justices before whom he is charged that he did not know of the same being so affected, and that he could not with reasonable diligence have obtained such knowledge.

Where any horse or animal so affected is exposed or otherwise dealt with in contravention of this section an inspection of the local authority or any officer of the local authority authorized to act in execution of this act may seize the same and cause it, if affected with glanders, cattle-plague, or sheep-pox, to be slaughtered, and if affected with any other contagious or infectious disease to be removed to some convenient or isolated place and to be there kept for such time as the local authority think expedient, and the local authority may recover the expenses of the execution by them of this section from the owner of the horse or animal, or from the consignor or consignee thereof, who may recover the same from the owner.

In case of a conviction of an offense under this section no compensation shall be payable in respect of any animals slaughtered under this section.

Notwithstanding anything in this section, the privy council may from time to time, by order, make such further or other provision as they think expedient respecting animals becoming affected with foot-and-mouth disease or any other contagious or infectious disease not being cattle-plague, pleuro-pneumonia, sheep-pox, or glanders while exposed or placed or being carried, led, or driven as aforesaid, and any such order shall be deemed part of this section.

An order of council (355) *dated August* 8, 1872, *refers to the cleansing and disinfection of markets, &c., in the following terms:*

1. This order may be cited as the market order of 1872.
2. This order extends to Great Britain only.
3. Words in this order have the same meaning as in the act of 1869.
4. Every local authority is hereby empowered to make from time to time, with the view of preventing the spreading of contagious or infectious disease among animals, regulations for the following purposes, or any of them:

(1.) For requiring the owners, lessees, or occupiers of places used for the holding of markets, fairs, exhibitions, or sales of animals, or for the lairage of animals, to cleanse those places from time to time at their own expense.

(2.) For requiring the owners, lessees, or occupiers of those places to disinfect the same, or any specified part thereof, from time to time at their own expense, where, in the judgment of the local authority, the circumstances are such as to allow of such disinfection being reasonably required.

(3.) For prescribing the mode in which such cleaning and such disinfection shall be effected.

5. Notwithstanding anything in the animals' order of 1871, article 39 of that order shall not apply to the cleansing and disinfecting of any such place as aforesaid.

6. If the owner, lessee, or occupier of any such place as aforesaid does any act in contravention of the regulations of a local authority under this order, or fails in respect to observe the same, it shall not be lawful for him or any other person at any time thereafter, until further order of the privy council, to hold a market, fair, exhibition, or sale of animals in that place, and the holding therein of any market, fair, exhibition, or sale of animals shall be and the same is hereby prohibited accordingly, and if any person holds any market, fair, exhibition, or sale of animals in contravention of this order, shall be deemed guilty of an offense against this order.

58. If any person places or keeps on any common or uninclosed land or in any field or other place insufficiently fenced, or on the side of a highway, any horse or animal affected with a contagious or infectious disease, he shall be deemed guilty of an offense against this act, unless he shows to the satisfaction of the justices before whom he is charged that he did not know of the same being so affected, and that he could not with reasonable diligence have obtained such knowledge.

59. Where a person having cattle in his possession or keeping within the district of a local authority wherein cattle plague exists affixes at the entrance to a building or inclosed place in or on which such cattle are kept a notice forbidding persons to enter into or on that building or place without his permission, then, if any person not having a right of entry or way into, on, or over that building or place, enters into, on, or

over the same or any part thereof, in contravention of the notice, he shall for every such offense be liable to a penalty not exceeding five pounds.

60. Every local authority shall cause every horse or animal that has died of glanders, cattle-plague, or sheep-pox, or has been slaughtered in consequence of being affected with glanders, cattle-plague, or sheep-pox, within their district, to be buried as soon as possible in its skin in some proper place, and to be covered with a sufficient quantity of quicklime or other disinfectant, and with not less than six feet of earth, or to be destroyed under inspection of the local authority in such mode as the privy council may from time to time by order direct or approve.

It shall not be lawful for any person, except with the license of the privy council, to dig up or cause to be dug up the carcass or any part of the carcass of any horse or animal so buried.

An order of council (341), *dated December* 20, 1871, *thus amends and renews the regulations relating to contagious or infectious disease among animals:*

Discovery and prevention of disease.

19. Every person having in his possession or under his charge an animal (including a horse) affected with a contagious or infectious disease shall observe the following rules:

(1.) He shall, as far as practicable, keep such animal separate from animals not so affected.

(2.) He shall with all practicable speed give notice to a police constable of the fact of the animal being so affected.

Such police constable shall forthwith give notice thereof to the inspector of the local authority, and (except in the case of foot-and-mouth disease) to the privy council.

20. Where an inspector finds in his district cattle-plague, pleuro-pneumonia, sheep-pox, sheep-scab, or glanders, he shall forthwith make a return thereof to the local authority and to the privy council, on a form provided by the privy council, with all particulars therein required, and shall continue to make a similar return on the Saturday of every week until the disease has disappeared.

21. Any dung of animals, and any hay, straw, litter, or other thing, commonly used for food of animals or otherwise for or about animals, may be moved out of an infected place within the metropolis (but not out of the metropolis) with a license signed by an officer of the local authority appointed on that behalf, certifying that the thing moved has been disinfected, but not otherwise.

22. Any officer authorized in this behalf by a local authority, or any constable or police officer, may stop and detain any animal (including a horse) which is being moved, or which he has reasonable grounds for suspecting is being moved, in contravention of the act of 1869 or any order of council, and may apprehend, without warrant, the person in charge thereof, and bring him before a justice, who shall inquire into the case in a summary manner, and may, if satisfied that there are good grounds for so suspecting, by writing under his hand, direct the animal to be detained, and the person in charge thereof to be brought before two justices as soon as practicable.

On such person being brought before two justices, they shall adjudicate on the case in a summary manner, and if satisfied that the animal was being moved in contravention as aforesaid, may direct it to be disposed of in conformity with the provisions of the act of 1869 or any order of council.

23. Any officer authorized in this behalf by a local authority, or any constable or police officer, may inspect any railway truck, cart, boat, or other vehicle used by land or by water, in which animals, including horses, hay, manure, litter, straw, and other articles used for or about animals are usually or at the time of such inspection carried, and may examine the person in charge thereof with a view to ascertain whether any animals or articles are being moved or carried in contravention of the act of 1869 or any order of council; and such officer may, if he has reasonable grounds for suspecting that such animals or articles are being moved or carried in contravention as aforesaid, apprehend, without warrant, the person in charge thereof, and bring him before a justice, who shall inquire into the case in a summary manner, and may, if satisfied that there are good grounds for so suspecting, by writing under his hand, direct the same to be obtained, and the person in charge thereof to be brought before two justices as soon as practicable.

On such person being brought before two justices, they shall adjudicate on the case in a summary manner, and if satisfied that the animals or articles were being moved or carried in contravention as aforesaid, may direct the same to be destroyed or otherwise disposed of in conformity with the provisions of the act of 1869 or any order of council.

24. Any person having charge of any animal (including a horse) or thing that is being moved on a highway, railway, canal, navigation, or river, for the moving whereof a license is requisite, shall, on being so required by an officer of a local authority au-

thorized in his behalf, or by a constable or police officer, produce the license (if any) for the moving of that animal or thing.

25. A constable or police or other officer, detaining any animal (including a horse) under the act of 1869 or any order of council, shall cause it to be supplied with requisite food and water during its detention; and any expenses incurred by him in respect thereof may be recovered from the person in charge of the animal or from its owner.

26. Any inspector or other officer empowered to carry the act of 1869 or any order of council into effect may, if authorized in this behalf by general or special order in writing of the local authority, enter, for the purpose of carrying into effect, the provisions of such act or order, any field, stable, cow-shed, or other premises within his district, where he has reasonable grounds for supposing that any animal affected with cattle-plauge or sheep-pox has been, or has been buried or otherwise disposed of.

If any person refuses admission to or obstructs or impedes, or aids in obstructing or impeding, such inspector or other officer, he shall be deemed guilty of an offense against this order.

27. A local authority may, from time to time, with the view of preventing the spreading of contagious or infectious disease, make regulations for the following purposes or any of them:

For prohibiting or regulating the movement of animals (including horses) on, to, from, and through, and the keeping thereof on commons and wastes and commonable and other lands whereon there exists a right of common or other right in the nature thereof.

For preventing any person from driving animals (including horses) under his charge, or allowing them to be driven or to stray into an inclosed field or place without the consent of the occupier thereof.

For preventing the spreading by means of dogs of any such disease.

For prohibiting or regulating the removal of hay, straw, litter, or other thing commonly used for food of animals, or otherwise for or about animals, that has been in the same field, stable, cow-shed, or other premises with animals affected with any contagious or infectious disease, or any dung that has been therein.

For providing for the cleansing and disinfection of sheds and places used by animals affected with any contagious or infectious disease.

Foot-and-mouth disease.

28. A local authority may, from time to time with the view of preventing the spreading of foot-and-mouth disease, make regulations for the following purposes, or any of them:

For prohibiting or regulating the movement out of any field, stable, cow-shed, or other premises in which foot-and-mouth disease has been found to exist, of any animal that has been in the same field, stable, cow-shed, or other premises with or in contact with any animal affected with foot-and-mouth disease.

Sheep-scab.

29. A local authority may, from time to time, with the view of preventing the spreading of sheep-scab, make regulations for the following purposes, or any of them:

For prohibiting any person from having in his possession or under his charge a sheep affected with sheep-scab, without treating that sheep, or causing it to be treated, with some dressing or dipping or other remedy for sheep-scab.

For prohibiting or regulating the movement out of any field, stable, cow-shed, or other premises, in which sheep-scab has been found to exist, of any sheep that has been in contact with, or in the same field, stable, cow-shed, or other premises, with any sheep affected with sheep-scab.

Pleuro-pneumonia.

30. A local authority may, from time to time, with a view of preventing the spreading of pleuro-pneumonia, make regulations for the following purposes, or any of them:

For prohibiting or regulating the removal out of any field, stable, cow-shed, or other premises, of the carcasses of any cattle which have died or have been slaughtered in consequence of being affected with pleuro-pneumonia.

Provided, that such local authority shall, from time to time, define the area within their district within which any such regulation shall have effect.

31. Where a local authority is authorized by the privy council to slaughter cattle affected with pleuro-pneumonia, such local authority may cause all cattle affected with pleuro-pneumonia within their district to be slaughtered, subject to the following provisions:

(1.) The local authority shall, by way of compensation for every such animal, pay to the owner thereof such sum, not exceeding one-half of the value of the animal immediately before it was affected with pleuro-pneumonia, as to the local authority seem fit.

(2.) They may require the value of any such animal to be ascertained by their officers, or by arbitration, and generally they may impose conditions as to evidence of the slaughter and value of any such animal.

(3.) They may, if they think fit, withhold compensation in respect of any such animal where the owner or the person having the charge thereof has, in their judgment, been guilty, in relation to such animal, of any act in contravention of the act of 1869, or of any order or regulation or license of the privy council or of a local authority, or has, in relation to such animal, failed to comply with the provisions of the act of 1869 or of any such order, regulation, or license in respect of the giving of notice of disease, or in any other respect.

32. The expenditure of a local authority in pursuance of this order in respect of compensation for cattle slaughtered as being affected with pleuro-pneumonia, shall be defrayed out of the local rate.

33. Where the local authority in pursuance of this order causes any animal to be slaughtered as affected with pleuro-pneumonia, the owner thereof shall not be entitled to recover in respect of the insurance thereof any sum, which, together with the payment which he receives for the same under this order, would exceed the sum which he would have been entitled to receive in respect of the insurance.

34. Every local authority shall keep, in such manner and form as the privy council from time to time direct or approve, a record, stating the date of any order made by them for slaughter under this order, and the execution of the order, and other proper particulars, and such record shall be evidence if any question arises concerning an order for the slaughter of any such animal or concerning compensation in respect thereof.

35. Where a local authority is authorized by the privy council to put in operation this provision of this order, such local authority may, from time to time, with the view of preventing the spreading of pleuro-pneumonia, prohibit or regulate the holding of any specified market, fair, auction, sale, or exhibition of cattle within their district.

An order of council (366), dated August 2, 1873, is important with regard to contagious pleuro-pneumonia and foot-and-mouth disease. It is as follows:

1. This order may be cited as the animals (amendment) order of 1873.

2. This order shall take effect from and immediately after the thirty-first day of August, one thousand eight hundred and seventy-three, and words in this order have the same meaning as in the act of 1869.

Pleuro-pneumonia.

3. Every local authority shall cause all cattle affected with pleuro-pneumonia within their district to be slaughtered.

The provisions numbered 1, 2, and 3, of article 31, and articles 32, 33, and 34, relating to compensation of the animals order of 1871, shall have effect in case of slaughter under this article of this order.

Foot-and-mouth disease.

4. Foot-and-mouth disease shall not be deemed to be a contagious or infectious disease within either of the following articles of the animals order of 1871, namely, articles 19 and 27.

Any regulations made by a local authority under the said article 27, as far as they relate to foot-and-mouth disease, are hereby revoked.

5. Where an animal becomes affected with foot-and-mouth disease while exposed or placed or being carried, led, or driven, as in section 57 of the act of 1869 mentioned, it may, notwithstanding anything in that section, be, with a license of an inspector of the local authority authorized to issue the same, but not otherwise, moved for purposes of feeding, or watering, or other ordinary purposes connected with the breeding or rearing of animals, to any land or building in the occupation of the owner of the animal, or for slaughter to the nearest slaughter-house, or some other slaughter-house approved by the local authority.

The form given in the second schedule to this order, or a form to the like effect, with such variations as circumstances require, shall be used.

Revocation.

6. The order and part of an order of council described in the first schedule to this order, and any regulations made by a local authority under that part of an order, are hereby revoked; provided that nothing in this order shall invalidate or make unlawful anything done under the said orders and part of an order and regulations, or in-

terfere with the institution or prosecution of any proceeding in respect of any offense committed against, or any penalty or forfeiture incurred under, the same.

An order in council, issued in June, 1874, revokes article 5 of the above; consequently articles 19, 27, and 28, of the animals (amendment) order of 1873 are restored.

Burial and disinfection.

36. Where, under section 60 of the act of 1869, a horse or animal is buried, its skin shall be first so slashed as to prevent its being of any use. The local authorities may, if they think fit, use for the purpose of such burial any place on the premises of the owner of the horse or animal.

37. Where a local authority is authorized by license from the privy council to destroy, under section 60 of the act of 1869, horses or animals that have died or been slaughtered as therein mentioned, every such horse or animal shall be destroyed in manner following, namely: The carcass thereof shall be disinfected, and shall then be removed, in charge of an officer of the local authority, to a horse-slaughterer's or knacker's yard, licensed for the purpose by the privy council, or other place so licensed, and shall be there destroyed by exposure to a high temperature, or by chemical agents. In every such case the local authority shall report to the privy council the fact and mode of destruction.

38. Where a local authority exercise the power of causing premises to be cleansed and disinfected, conferred on them by the act of 1869, or by any order of council, the occupier of those premises shall give all facilities for that purpose.

39. Where any landing-place, lair, shed, or other place, is directed by the act of 1869, or any order of council, or is ordered by a local authority, to be cleansed and disinfected, it shall be cleansed and disinfected in manner following:

(1.) By the sweeping out thereof, and the effectual removal therefrom of all dung, sawdust, litter, and other matter.

(2.) Then by thorough washing therewith with water.

(3.) Then by the application to the floor and to all parts above the floor with which animals or their droppings have come in contact, of a coating of lime, made by mixing good freshly-burnt lime with water, and containing in each gallon of lime-wash either one-fifth of a pint of commercial carbolic acid, or one-fifth of a pint of commercial cresylic acid, or four ounces of fresh dry chloride of lime, such as lime-wash to be prepared immediately before use.

The sweepings of the landing-place, lair, shed, or other place shall be well mixed with quicklime, and effectually removed from contact with animals.

General provisions.

40. A local authority may from time to time revoke or alter any order, prohibition, or regulation made by them under the act of 1869 or any order of council.

41. Every local authority shall send to the privy council a copy of every order, prohibition, or regulation made by them.

42. If the privy council are satisfied on inquiry with respect to any prohibition or regulation made by a local authority under the act of 1869, or any order of council, that the same is of too restrictive a character, or otherwise objectionable, and direct the revocation thereof, the same shall thereupon cease to operate.

43. Whenever there is any change in the name or address of any inspector appointed under section 12 of the act of 1869, or in the district of any such inspector, the local authority shall forthwith report the same to the privy council.

44. Except where otherwise provided for in any order of council, a local authority shall provide and supply, without charge, printed copies of documents or forms requisite under the act of 1869, or any order of council.

45. Every regulation made by a local authority under any order of council shall (where no other provision is made for the publication thereof) be published by advertisement in a newspaper circulating in the district of the local authority.

46. If any person fails to give, produce, do, or observe any notice, license, thing, or rule which he is by this order or by any order or regulation of a local authority thereunder required to give, produce, do, or observe, he shall in every such case be deemed guilty of an offense against this order.

47. If any animal (including a horse) or anything is moved or dealt with in contravention of this order or of any order or regulation of a local authority thereunder, the owner thereof and the person directing or permitting such movement thereof or dealing therewith, and the person or company in charge of or removing or conveying the same, shall each be deemed guilty of an offense against this order.

48. All orders and regulations made by a local authority under any former order of council and in force at the commencement of this order shall, as far as the same are not varied by or inconsistent with this order, remain in force until altered or revoked by the local authority.

61. A local authority shall cause the yard, shed, stable, field, or other premises in which any horse or animal affected with glanders or cattle-plague or sheep-pox has been kept while so affected, or has died or been slaughtered, to be thoroughly cleansed and disinfected, and all hay, straw, litter, dung, or other article that has been in contact with or used about any such horse or animal, to be burned or otherwise destroyed.

No fresh animal shall be admitted into any yard, shed, stable, field, or other premises in which any animal affected with cattle-plague or sheep-pox has been kept while so affected, or has died or been slaughtered, until the expiration of thirty days after the cleansing and disinfecting of such premises in pursuance of this act.

Any such hay, straw, litter, dung, or other article shall not be removed from the premises in which any horse or animal affected with glanders or cattle-plague has been, except for the purpose of being destroyed, nor shall it be removed out of the district of the local authority without the consent in writing of the local authority into whose district it is moved. If any such thing is removed in contravention of this act, the occupier of the premises from which it is removed and the person removing it shall be deemed guilty of an offense against this act.

A local authority shall direct the disinfecting of the clothes of, and the use of due precautions against the spreading of contagion by, inspectors and others in contact with animals affected with cattle-plague.

62. Every steamboat, railway, and other public company, and every person carrying animals for hire to or in Great Britain, shall thoroughlycleanse and disinfect, in such manner as the privy council from time to time by order direct, all steamers, vessels, boats, pens, carriages, trucks, horse-boxes, and vehicles used by such company or person for the carrying of animals.

If any company or person on any occasion fails to comply with the requisitions of any such order, such company or person shall on every such occasion be deemed guilty of an offense against this act.

An inspector of a local authority or any officer of a local authority authorized to execute this act, may at all times enter on board any steamer, vessel, or boat in respect whereof he has reasonable grounds for supposing that any company or person has failed to comply with the requisitions of any such order, and on premises where he has reasonable grounds for supposing that any pen, carriage, truck, horse-box, or vehicle in respect whereof any company or person has on any occasion so failed is to be found; any if any company or person refuses admission to an inspector or other officer acting under this section, such company or person shall be deemed guilty of an offense against this act.

63. The privy council may from time to time, by order, give directions respecting modes of disinfecting, and anything disinfected in accordance with the provisions of such order, or in accordance with any process of disinfection approved by the privy council, shall be deemed disinfected within this act, but not otherwise.

64. Every railway company shall make a provision to the satisfaction of the privy council, of water and food, or either of them, at such stations as the privy council from time to time by general or specific description direct, for animals carried or about to be, or having been, carried on the railway of the company; and such water and food, or either of them, shall be supplied to any such animal by the company carrying it on the request in writing of the consignor thereof, or on the request of any person in charge thereof, and the company so supplying water and food, or either of them, may make in respect thereof such reasonable charges, if any, as the privy council by order approve, in addition to such charges as they are for the time being authorized to make in respect of the carriage of animals, and the amount of such additional charges accrued due in respect of any animal shall be a debt from the consignor and from the consignee thereof to the company, and shall be recoverable by the company from either of them by proceedings in any court of competent jurisdiction, and the company shall have a lien for the amount thereof on the animal in respect of which the same accrued due, and on any other animal at any time consigned by the same person to be carried by the company.

If any company on any occasion fails to comply with the requirements of this section, they shall on every such occasion be deemed guilty of an offense against this act. If in the case of any animal such a request as aforesaid is not made so that the animal remains without a supply of water for thirty consecutive hours, or other period not being less than twelve hours, as the privy council from time to time by order prescribe, the consignor and the person in charge of the animal shall each be deemed guilty of an offense against this act; and it shall lie on the person accused to prove the time within which the animal has had a supply of water.

By an order of council (341) *dated December* 20, 1871, *the following renewed and amended regulations with regard to transit are made:*

Transit of animals by sea.

5. In this part of this order the term "animals" extends to all ruminating animals and to horses.

6. With respect to places used for animals on board vessels, the following regulations shall have effect:

(1.) Every such place shall be divided into pens by substantial divisions.

(2.) Each pen shall not exceed 9 feet in breadth, or 15 feet in length.

(3.) The floor of each pen shall have proper battens or other footholds thereon.

(4.) Every such place, if inclosed, shall be ventilated by means of separate inlet and outlet openings, of such size and position as will secure a proper supply of air to the place in all states of weather.

7. Between each first day of November and the following thirtieth day of April (both days inclusive) freshly shorn sheep shall not be carried on the deck of a vessel.

8. When sheep are carried on the deck of a vessel, proper gangways shall be provided either between or above the pens in which the sheep are carried.

9. Animals landed from a vessel shall, on a certificate of an inspector appointed by the privy council in that behalf, certifying to the effect that the foregoing regulations, or some one of them, have not or has not been observed in the vessel, be detained at the landing-place or in lairs adjacent thereto, until the privy council otherwise direct.

Cleansing and disinfection of vessels.

10. Every vessel used for carrying animals shall, after the close of each voyage, and before any fresh cargo is put on board, be cleansed and disinfected in manner following:

(1.) By the sweeping out of the hold and every other part of the vessel used for animals, and the actual removal therefrom of all dung and litter, and of all ashes, sand, sawdust, and other matter with which animals or their droppings have come in contact.

(2.) Then by the thorough washing of the same parts of the vessel with water.

(3.) Then by the application to the sides, floor, and ceiling of the hold and to every other part of the vessel with which animals or their droppings have come in contact, of a coating of limewash made by mixing good, freshly-burnt lime with water, and containing in each gallon of limewash either one-fifth of a pint of commercial carbolic acid or one-fifth of a pint of commercial cresylic acid, or four ounces of fresh dry chloride of lime, such limewash to be prepared immediately before use.

The sweepings of the vessel shall be well mixed with quicklime, and effectually removed from contact with animals.

Shipping and unshipping places.

11. At every place where animals are put on board of or landed from vessels, provision shall be made, to the satisfaction of the privy council, for a supply of water for animals, and water shall be supplied there, gratuitously, on request of any person in charge of any animals.

12. At every place where animals are landed from vessels, provision shall be made, to the satisfaction of the privy council, for the speedy and convenient unshipment of animals, and for a supply of food for them; and food shall be supplied there, on request of any person in charge of any animals, at such price as the privy council from time to time approve.

Cleansing and disinfection of landing-places.

13. Where any animal affected with any contagious or infectious disease is landed at a port, or is, while so affected, in or at any landing-place or lair, or other place adjacent thereto, then the landing-place and every such lair or other place where the animal has been shall not be used for any animals not forming part of the same cargo unless and until it has been cleansed and disinfected.

Transit of animals by railway.

14. Every truck used for carrying animals on a railway shall be provided with spring buffers, and the floor thereof shall have proper battens or other foothold thereon.

15. A railway company shall not allow any truck used for carrying animals on their railway to be overcrowded so as to cause unnecessary suffering to the animals therein.

16. Between each 1st day of November and the next following 30th day of April (both days inclusive), trucks used for carrying on a railway sheep freshly shorn and unclothed shall be covered and inclosed so as to protect the sheep from the weather, but shall be properly ventilated.

Cleansing and disinfection of pens and vehicles.

17. Every pen, carriage, truck, horse-box, or vehicle used for carrying animals on land, shall, on every occasion after any animal is taken out of the same and before any other animal is placed therein, be cleansed and disinfected in manner following:

(1.) By the sweeping out of the pen, carriage, truck, horse-box, or vehicle, and the effectual removal therefrom of all dung, sawdust, litter, and other matter.

(2.) Then by the thorough washing of the pen, carriage, truck, horse-box, or vehicle with water.

(3.) Then, in case of a pen, carriage, or truck, by the application to the floor and to all parts above the floor with which animals or their droppings have come in contact, of a coating of limewash, made by mixing good, freshly-burnt lime with water, and containing in each gallon of limewash either one-fifth of a pint of commercial carbolic acid or one-fifth of a pint of commercial cresylic acid, or four ounces of fresh, dry chloride of lime, such limewash to be prepared immediately before use.

The sweeping of the pen, carriage, truck, horse-box, or vehicle shall be well mixed with quicklime and carefully removed from contact with animals.

PENALTIES.

18. If anything is done or omitted to be done in contravention of any of the regulations of this part of this order, the owner and the master or person having charge or command of the vessel in which; and the owner and the occupier of the place where animals are put on board of or landed from vessels at which; and the company carrying animals on or owning or working a railway on which; and also in case of the overcrowding of a truck on a railway, or of the carrying on a railway of sheep freshly shorn and unclothed, the consignor of the animals in respect of which (as the case may be) such thing is done or omitted, shall severally be deemed guilty of an offense against this order.

Provided, that no person shall be liable to a penalty under this part of this order in respect of sheep as freshly shorn, where it is proved that the sheep have not been shorn within sixty days before the time of the commission of the alleged offense.

By an order in council (349) *dated July* 11, 1872, *the following regulation was to take effect from July* 3 (1) *of that year:*

(2.) This order may be cited as the carcasses of animals order of 1872.

(3.) In this order—

The act of 1869 means the contagious-diseases (animals) act, 1869.

Master includes any person having the charge or command of a vessel.

Other terms have the same meaning as in the act of 1869.

4. In addition to the powers and duties vested in and imposed on local authorities by section sixty of the act of 1869, and by articles 36 and 37 of the animals order of 1871, every local authority is hereby empowered to make, from time to time, with the view of preventing the spreading of contagious or infectious diseases among animals, regulations for the following purpose:

For securing the burial, in accordance with directions of article 36 of the animals order of 1871, of the carcasses, being within the district of the local authority of animals (including horses) which have died of any contagious or infectious disease, or the destruction thereof, under inspection of the local authority, in the mode prescribed by article 37 of the animals order of 1871.

5. If an animal (including a horse) on board a vessel in Great Britain, or within three miles of the shore thereof, dies of or is slaughtered in consequence of being affected with a contagious or infectious disease, the master of the vessel shall, with all practicable speed, cause the carcass thereof to be disinfected on board the vessel in such mode as the privy council from time to time may direct or approve.

If he fails to do so, he shall be deemed guilty of an offense against this order.

6. If any person throws or places, or causes or suffers to be thrown or placed, into or in any river, stream, canal, or other water in Great Britain, or into or in the sea within three miles of the shore of Great Britain, the carcass of an animal (including a horse) which has died of or been slaughtered in consequence of being affected with a contagious or infectious disease, he shall be deemed guilty of an offense against this order, unless he shows to the satisfaction of the justices before whom he is charged that he did not know that the same had so died or been slaughtered, and that he could not with reasonable diligence have obtained that knowledge.

7. It shall not be lawful for any person, except with the license of the privy council, to dig up, or cause to be dug up, the carcass or any part of the carcass of any animal (including a horse) buried under a regulation of a local authority or under the direction of a receiver of wreck.

If any person acts in contravention of this article he shall be deemed guilty of an offense against this order.

PART V.—SLAUGHTER IN CATTLE-PLAGUE; COMPENSATION.

65. Every local authority shall cause all animals affected with cattle-plague within their district to be slaughtered.

66. A local authority may, if they think fit, cause to be slaughtered any animal that has been in the same shed or stable, or in the same herd or flock, or in contact with any animal affected with cattle-plague within their district.

67. Where an animal is affected with disease suspected to be cattle-plague the local authority may cause the animal to be slaughtered in order to ascertain the nature of the disease.

68. Where any animal affected with cattle-plague, or affected with disease suspected to be cattle-plague, is slaughtered in pursuance of this act, the local authority (except as otherwise provided in this act) shall, by way of compensation for the animal, pay to the owner thereof such sum, not exceeding twenty pounds and not exceeding one-half of the value of the animal immediately before it was affected with cattle-plague, as to the local authority seems fit.

69. When a local authority causes an animal to be slaughtered on account of it having been in the same shed or stable, or in the same herd or flock, or in contact with an animal affected with cattle-plague, the owner of the animal so slaughtered may either dispose of the carcass on his own account, with a license from some officer appointed in that behalf by the local authority, or may require the local authority to dispose of the same, in which latter case the local authority shall pay to the owner thereof, by way of compensation, such sum, not exceeding thirty pounds, as may equal three-fourths of the value of the animal slaughtered.

70. A local authority may require the value of any animal slaughtered under this act to be ascertained by officers of the local authority or by arbitration, and generally may impose conditions as to evidence of the slaughter and value of the animals slaughtered.

71. A local authority may, if they think fit, withhold compensation in respect to any animal slaughtered, where the owner or the person having the charge thereof has in their judgment been guilty, in relation to such animal, of any act in contravention of this act, or of any order, regulation, or license of the privy council or a local authority, or has, in relation to such animal, failed to comply with the provisions of this act, or of any such order, regulation or license in respect of the giving notice of disease or in any other respect, and may, if they think fit, withhold compensation in respect of a foreign animal slaughtered on account of it being affected with cattle-plague, or with disease suspected to be cattle-plague, if it appears to them that the animal was so affected at the time of the landing thereof.

72. Where an animal has been slaughtered in pursuance of this act the owner thereof shall not be entitled to recover in respect of the insurance thereof any sum which, together with the payment which he receives for the same under this act, would exceed the sum which he would have been entitled to receive in respect of the insurance.

73. The privy council may, notwithstanding anything in this act, reserve for experimental treatment any animal ordered to be slaughtered under this act, but compensation shall be payable in respect thereof as if this section had not been enacted.

74. Every local authority shall keep, in such manner and form as the privy council from time to time by order direct or approve, a record relative to proceedings under this part of this act, stating the date of any order for slaughter, and the execution of the order, or the reservation of the animal for experimental treatment (as the case may be), and other proper particulars, and such record shall be evidence if any question arises concerning an order for the slaughter of any animal, or concerning compensation in respect thereof.

PART VI.—ORDERS OF COUNCIL AND LOCAL AUTHORITIES.

75. The privy council may from time to time make such orders as they think expedient for all or any of the following purposes:

For insuring for animals brought by sea to ports in Great Britain a proper supply of food and water during the passage and on landing.

For protecting such animals from unnecessary suffering during the passage and on landing.

For protecting animals from unnecessary suffering during inland transit.

For prohibiting or regulating the movement of animals, and the removal of dead animals or parts thereof, and of hay, straw, litter, dung, and other things likely to spread contagious or infectious diseases among animals.

For requiring the cleansing and disinfecting of yards, sheds, stables, fields, and other premises.

For regulating the disposal of animals dying while affected with a contagious or infectious disease.

For requiring notice of the appearance of any such disease among animals.

For prohibiting or regulating the holding markets, fairs, exhibitions or sales of animals.

And generally any orders whatsoever, which they think it expedient to make for the better execution of this act, or for the purpose of in any manner preventing the introduction or spreading of contagious or infectious disease among animals in Great Britain (whether any such orders are of the same kind as the kinds enumerated in this section or not), and may in any such order direct or authorize the slaughtering of animals that are affected with any contagious or infectious disease, or that have been in contact with animals so infected; and may in any such order direct or authorize the local authority to pay compensation for any animals so slaughtered; and may in any such order impose penalties for offenses against the same, not exceeding the sum of twenty pounds for any such offense, and so that in every such order provision be made that a penalty less than the maximum may be ordered to be paid; and this section shall extend to horses and all ruminating animals not within the definition of animals in this act.

Every such order shall have the like force and effect as if it had been enacted by this act.

76. A person, for the time being, appointed by the privy council an inspector for the purposes of this act shall have for and throughout Great Britain all such powers, authorities, and privileges as an inspector of a local authority has within or in relation to his district; and a direction of the privy council shall in the case of an inspector appointed by them to be deemed equivalent to a direction of a local authority in the case of an inspector appointed by them.

77. The privy council may from time to time, by order, declare that such of the provisions of this act, and of any order of the privy council under it, as relates to the metropolis, or any of these provisions, shall also extend and apply to any town, city, parish, or place specified in the order, and the same shall extend to such town, city, parish, or place accordingly; and the privy council may at any time revoke or from time to time vary any such order.

78. The privy council may from time to time, by order, make such regulations as they think expedient for prohibiting or regulating the landing of any hay, straw, fodder, or other article brought from any place out of the United Kingdom, whereby it appears to the privy council contagion or infection may be conveyed to animals, or for causing the same to be destroyed if landed.

If any person lands, or attempts to land, any hay, straw, fodder, or other article in contravention of any such order, the same shall be forfeited in like manner as goods the importation whereof is prohibited by the acts relating to the customs are liable to be forfeited; and the person so offending shall be liable to such penalties as are imposed on persons importing or attempting to import goods the importation whereof is prohibited by the acts relating to the customs, without prejudice to any proceeding against him under this act or any such order, but so that no person be punished twice for the same offense.

79. The privy council may require a local authority to carry into effect any order of the privy council under this act, and may authorize a local authority to make any regulations for the purpose of preventing the spreading of contagious or infectious diseases among animals, subject to such conditions as the privy council impose; and the local authority may by any such regulation impose such penalties as the privy council are by this act authorized to impose by order.

80. The expenses incurred by a local authority in executing any order of the privy council under this act shall be defrayed by the local authority out of such local rates or funds as such order directs, and the subject to or in the absence of any such direction shall be deemed expenses incurred by the local authority in pursuance of this act.

81. Every order of the privy council under this act shall be published in the London Gazette, save that where an order of the privy council affects only a particular port, town, or place, or part thereof, specified in the order, or declares a place to be an infected place, or to be free from cattle-plague or from sheep-pox, or is in the nature of a license under an order of council, or of a revocation of such a license, then the insertion in the London Gazette of a notice of the issuing thereof shall be for all purposes sufficient publication thereof.

Any order of the privy council under this act shall be published by and at the expense of any local authority to whom the same is sent by the privy council for publication, in some newspaper circulating in the district of the local authority, or in such other manner as the privy council direct.

Any order or regulation made by a local authority shall be published by them, at their own expense, in such manner as the privy council direct and subject to, or, in the absence of any such direction, in such manner as the local authority think sufficient and proper to insure publicity.

82. Any order, license, regulation, or other instrument made under this act or under any order of the privy council thereunder, may be in writing or print, or partly in writing and partly in print.

83. No stamp duty shall be payable on, and no fee or other charge shall be demanded or made for, any appointment, certificate, declaration, or license under this act, or any order or regulation made thereunder.

84. An order or regulation made or issued by a local authority under this act or under any order of the privy council may be proved as follows:

By the production of a copy of a newspaper containing a copy of such order or regulation; or

By the production of a printed copy of such order or regulation purporting to be certified to be a true copy by the clerk of the peace where the authority are justices in general or quarter sessions assembled, or by the town clerk or other officer performing the duties of a town clerk in the case of an authority having a town clerk or other officer as aforesaid, or by such other officer as the privy council prescribes.

And any such order or regulation shall, until the contrary is proved, be deemed to have been duly made and issued at the time at which it bears date.

·85. Penalties and forfeitures shall be recoverable and applicable under an order of the privy council or an order or regulation of a local authority, as penalties and forfeitures under this act are recoverable and applicable.

Part VII.—Lands.

86. A local authority may purchase or take on lease or at a rent land for the purpose of burying therein animals dying of or slaughtered on account of any contagious or infectious disease, or for the purpose of providing wharves, lairs, sheds, markets, houses, and places for the landing, reception sale, and slaughter of foreign animals, or for any other purpose of this act, and may sell, exchange, or dispose of lands acquired by them under this act, but not required to be retained for the purposes thereof, carrying the money produced thereby to the credit of the local rate.

87. Land purchased or taken on lease or at a rent under this act by a local authority, not being a body corporate, shall be assured or demised to the local authority and their successors, in trust for the purposes of this act, and shall be accepted, taken, and held by them as a body corporate.

88. The regulations contained in section seventy-five of the local government act, 1858, shall be observed with respect to the purchase of land by a local authority for the purposes of this act, and shall apply and have effect as if the local authority were a local board acting under the local government act, and the purposes of this act were purposes of that act, save that the advertisements and notices requisite under that section may be published and served in any two consecutive months instead of only in the months therein specified, and that the local rate be substituted for the rates therein mentioned; and the powers conferred by this section may be exercised by a local authority with respect to land either within or without their district.

Part VIII.—Expenses of local authorities.

89. The expenditure of a local authority in compensation for animals slaughtered under Part V of this act, or in respect of principal of or interest on money borrowed in pursuance of this act, shall be defrayed out of the local rate, or out of a separate rate to be levied in all respects as the local rate, and included under the term local rate.

Any person who is not the owner of the premises in respect of which he is rated under this section to the local rate may deduct from the growing rent due to the owner of such premises one-half of the rate payable by him for the purposes of this section, and every owner shall allow such deduction accordingly.

The owner for the purposes of this section shall be the person for the time being entitled to receive the rack rent of the premises in respect of which the rate is made on his own account, or who would be entitled to receive the same if such premises were let at a rack-rent, including under the term rack-rent any rent which is not less than two-thirds of the net annual value of the premises out of which the rent issues.

Every local authority shall have power, notwithstanding any limit in any act of Parliament, to levy a local rate to the amount required for the purposes of this act, but every rate or increase of rate levied under this section shall in all precepts for the levy thereof be described as a separate rate or separate item of rate, and when collected from the individual rate-payers shall be collected as a separate rate or specified as a separate item of rate.

Every order of a board of guardians for contribution of moneys, out of which any such expenditure as in this section mentioned is payable, shall state the amount, in the pound of contribution, required for such expenditure; and the overseers, on the receipt given to any rate-payer for poor rate, shall specify the amount (if any) collected in respect of such expenditure.

90. Expenses incurred by a local authority in pursuance of this act, other than in their expenditure in compensation for animals slaughtered under Part V of this act, or in respect of principal of or interest on money borrowed in pursuance of this act, shall be defrayed out of the local rate.

91. Where before the twentieth day of February, one thousand eight hundred and

sixty-six, any person suffered so great a loss of cattle by cattle-plague as to entitle him, after the passage of this act, in the opinion of the local authority, to a remission in whole or in part of the amount due from him in respect of the local rate, such remission may be granted by the local authority.

92. Where, at the passing of this act, a local authority have in their hands an unappropriated balance of a local rate levied under any act repealed by this act, they may, if they think fit, apply any part of such balance in compensation for cattle slaughtered between the passing of "the cattle-disease prevention act, 1866," and the appointment of inspectors under that act, by direction of a person whom the owner of such cattle had reasonable ground to believe to be the authorized inspector for the execution of the act, or they may carry such balance, or any part thereof, to the credit of the ordinary account of the local rate, to be applied for any of the purposes for which the local rate, when levied under any act other than an act repealed by this act, is applicable.

93. All precepts, orders for contribution, and forms of poor rate shall, where necessary, be varied in such manner as may be required for carrying into effect this act.

94. The treasurer of a local authority may, if directed by them, advance out of any moneys for the time being in his hands, any sum required for payment of expenses incurred by them in pursuance of this act.

95. Where the local rate is a county rate or borough rate, or any other such rate as is mentioned in the second schedule to this act, all the provisions of the statutes applicable to the making, levying, and collecting of a county rate, borough rate, or such other rate shall apply, notwithstanding that the whole of such rate, or any part thereof, is applicable to the payment of the expenditure of a local authority in pursuance of this act, in compensation for animals slaughtered, or in respect of principal of or interest on money borrowed in pursuance of this act.

96. An error in the statement of the amount of expenses in any precept, warrant, contribution, order, or receipt issued or given under this act shall not invalidate such precept, warrant, contribution, order, or receipt; but any person aggrieved by the error may appeal to the justices in petty sessions and the justices may rectify the error and award to the appellant compensation for any loss he may have sustained thereby, the amount of such compensation to be paid to the appellant, and to be deemed expenses of the local authority under this act.

97. Notwithstanding anything in this act, the local authority of each borough situate within a county and assessed to the county rate thereof, shall be recouped the proportionate amount contributed by the borough to the expenses incurred by the local authority of the county in pursuance of this act, including expenditure in compensation for animals slaughtered, or in respect of principal of or interest on money borrowed in pursuance of this act, so that the burden of those expenses shall be borne wholly by the county, and not, as to any part thereof, by any borough situate within the county.

Borrowing.

98. Where the rate levied or required for the purposes of this act exceeds or would exceed sixpence in the pound, a local authority may, for the purposes of defraying any costs, charges, and expenses under this act, borrow at interest on the credit of the local rate any sums of money necessary for defraying such costs, charges, and expenses; and for the purpose of securing the repayment of any sums of money so borrowed, together with such interest as aforesaid, the local authority may mortgage the local rate for any period not exceeding seven years.

Where the rate levied or required for the purposes of this act exceeds or would exceed ninepence in the pound, the commissioners of Her Majesty's treasury may, on application from the local authority, extend the term to any term not exceeding fourteen years, and the local authority may mortgage the rate accordingly: Provided that where the local authority borrow for any purpose of this act on any security other than the local rate (whether together with the local rate, if any, or separately therefrom), the limitations in this section contained respecting the amount of rate and the term of years shall not operate.

The provisions of the commissioners' clauses act, 1847, with respect to the mortgages to be executed by the commissioners shall be incorporated with this section, the local authority being deemed to be the commissioners, and any mortgagee or assignee may enforce payment of his principal and interest by appointment of a receiver.

The public-works loan commissioners may, with the approval of the commissioners of Her Majesty's treasury, advance to a local authority, on the security of the local rate, without any further security, any sums of money to be applied for the purposes of this act, and to be repaid with interest within any period as aforesaid.

99. Where the estimated amount of the sum required to be levied for payment of the expenditure of a local authority in pursuance of this act (including expenditure incurred in the payment of money borrowed or of interest thereon) exceeds the sum that would be raised by the levying of a rate of one shilling in the pound on the

ratable value of the property assessed to the local rate, the local authority may borrow from the public-works loan commissioners, and the public-works loan commissioners may, out of the balance for the time being unapplied of any money by any act already passed authorized to be issued for the purposes of loans under any act repealed by this act, or out of any other money for the time being authorized to be issued for the purposes of loans under this section, lend to them such sums as may be required, subject to the following conditions:

(1.) Every such loan shall be made with the sanction of the commissioners of Her Majesty's treasury.

(2.) Interest shall be at the rate of 3½ per centum per annum.

(3.) Repayment of the loan shall be made by such number of equal annual installments, not exceeding thirty, as the commissioners of Her Majesty's treasury direct.

(4.) The commissioners of Her Majesty's treasury may, if they think fit, authorize the postponement for a period not exceeding two years, of any payment of principal or interest becoming due within the first three years.

(5.) Repayment of the loan and interest shall be secured by a mortgage of the local rate, and it shall not be incumbent on the public-works loan commissioners to require any other security.

(6.) The local authority shall have power to levy, and shall levy, rates requisite for the purpose of repaying the loan with interest.

(7.) The sanction of the commissioners of Her Majesty's treasury to the loan shall be conclusive evidence that it is authorized by this act; and no objection shall be made by any rate-payer to the validity of any mortgage for the loan, or to the application of the proceeds of the local rate to the payment of the principal or interest of the loan.

(8.) The commissioners of Her Majesty's treasury may, by agreement with the local authority borrowing, commute into one equivalent annuity, terminable at the time fixed for the liquidation of the annual installments aforesaid, the payments secured by the mortgage, or any portion of such payments.

100. Where a local authority have borrowed money on the security of a mortgage of the local rate, under any act repealed by this act, then (except as otherwise provided in this act with respect to the county of Chester), notwithstanding any repeal in this act, or any alteration made by this act in the definition of a local authority or local rate, or any other thing in this act contained, the local rate mortgaged shall continue to be the security for the money borrowed, as if this act had not been passed; and in relation to the money so borrowed the local authority which borrowed such money, and the local rate on which the same is charged, shall continue to be the local authority, and the local rate under the acts repealed by this act as if this act had not been passed; and all provisions of Part II of the cattle-diseases prevention act, 1866, relative to expenses, and all the provisions of the cattle-diseases prevention amendment act, 1866, and all other provisions of any act repealed by this act relative to expenses, and all the provisions of the cattle-diseases prevention amendment act, 1866, and all other provisions of any act repealed by this act relative to expenses of local authorities, rating, remission of rates, and borrowing, and matters connected therewith respectively, shall, in relation to the money so borrowed, and to the rate charged therewith, continue to operate as if this act had not been passed.

101. With respect to the county of Chester the following provisions shall have effect:

(1.) As far as regards the expenditure of the local authority of the county of Chester in respect of principal of or interest on money borrowed in pursuance of any act repealed by this act, and any matter consequent on or relative to that expenditure (including the remission of rates), the foregoing provisions of this part of this act shall not apply to that county.

(2.) That expenditure shall be defrayed out of the county rate for the county of Chester, or out of any money applicable under any act of Parliament, or otherwise, for the public charges or uses of that county, or partly out of one and partly of the other; such county rate to be assessed, levied, and collected in the manner prescribed by law for the assessment, levying, and collection of county rates, independently of this act or of any act repealed by this act.

(3.) In lieu of any provision authorizing deduction by tenant from landlord of half of the local rate, any person who is not the owner of the premises in the county of Chester in respect of which he is rated to the poor rate may, in each year until the first day of November, one thousand eight hundred and ninety-six, in which he duly pays his poor rate, deduct from the growing rent due to the owner of such premises a sum equal to one penny in the pound on the annual ratable value of such premises, and every owner shall allow such deduction accordingly; and the owner, for the purposes of this section, shall be the person defined as such in this part of this act.

(4.) The local authority for the county of Chester shall entertain and decide on applications from rate-payers to whom, if this section had not been inserted in this act, remission in respect of local rate might have been granted, and may, on such applications, grant to the applicants, or any of them, such sum or sums of money (if any) out of the county rate as the local authority think reasonable, regard being had to the extent of loss in the cases of the several applicants.

(5.) The local authority of each borough situate within the county of Chester and assessed to the county rate thereof, shall, by means of repayment out of the county rate, or by means of differential rates, or partly in the one way and partly in the other, be recouped the proportionate amount contributed by the borough to any money granted as aforesaid, so that the burden of the expenditure incurred by the local authority of the county in respect of such grants shall be borne wholly by the county, and not as to any part thereof by any borough situate within the county; but nothing in this section shall prejudicially affect the mortgage security of the public-works loan commissioners for the money advanced to the local authority of the county of Chester under any act repealed by this act; and the local authority of that county shall, from time to time, levy such rates as are under this section applicable, and as are for the time being requisite (either wholly or in conjunction with such other money as in this section mentioned) for the purpose of repaying with interest the money advanced on such mortgage security according to the terms thereof.

102. The existence of any order or precept for the making or collection under any act repealed by this act of any rate remaining uncollected, wholly or in part, at the passing of this act shall not affect the validity of any rate made after the passage of this act.

PART IX.—OFFENSES AND LEGAL PROCEEDINGS.

103. If any person acts in contravention of or if guilty of any offense against this act, or any order or regulation made by the privy council or a local authority in pursuance of this act, he shall for every such offense (except as otherwise provided in this act, and except where a less penalty is provided in any such order of regulation) be liable to a penalty not exceeding twenty pounds.

Where any such offense is committed with respect to more than four animals, a penalty not exceeding five pounds for each animal may be imposed instead of the penalty of twenty pounds.

Where any such offense is committed in relation to offal, dung, hay, straw, litter, or anything, a further penalty, not exceeding ten pounds, may be imposed in respect of every half ton in weight of such offal, or other thing, after the first half ton.

104. If any person does any of the following things he shall be deemed guilty of an offense against this act:

(1.) If he does anything for which a license is requisite under this act, or any order of the privy council thereunder, without having obtained a license.

(2.) If where such a license is requisite, having obtained a license in that behalf, he does the thing licensed after the license has expired.

(3.) If he uses or offers or attempts to use as such a license an instrument not being a complete license, or an instrument untruly purporting or appearing to be a license, unless he shows to the satisfaction of the justices before whom he is charged that he did not know of such incompleteness or untruth, and that he could not with reasonble diligence have obtained such knowledge.

(4.) If with intent to evade any provision of this act, or of any order of the privy council thereunder, he fabricates or alters, or offers or utters, knowing the same to be fabricated or altered, any license, declaration, certificate or instrument made or issued, or purporting to be made or issued, under or for any purpose of this act or any such order.

(5.) If for the purpose of obtaining any license, certificate, or instrument under or for the purposes of any such provision, he makes a declaration false in any material particular, unless he shows to the satisfaction of the justices before whom he is charged that he did not know of such falsity, and that he could not with reasonable diligence have obtained such knowledge.

(6.) If he obtains or endeavors to obtain any such license, certificate, or instrument by means of any false pretense, unless he shows to the satisfaction of the justices before whom he is charged that he did not know of such falsity, and he could not with reasonable diligence have obtained such knowledge.

(7.) If he grants or issues any such license, certificate, or instrument, being false in any material particular, unless he shows to the satisfaction of the justices before whom he is charged that he did not know of such falsity, and that he could not with reasonable diligence have obtained such knowledge.

And in any such case he shall be liable, on conviction, in discretion of the justices, to be imprisoned for any term not exceeding three months, with or without hard labor, in lieu of the pecuniary penalty to which he is liable under this act.

105. If any person obstructs or impedes an inspector or other officer acting in execution of this act, or of any order of the privy council thereunder, he, and every person aiding and assisting him therein, shall be guilty of an offense against this act, and

the inspector or other officer, or any person whom he calls to his assistance, may seize the offender and detain him until he can be conveniently taken before a justice, to be dealt with according to law.

106. Notwithstanding anything in any act relating to the metropolitan police or to municipal corporations, or in any other act, one-half of every penalty or forfeiture recovered under this act shall be paid to the person who sues or proceeds for the same, and the other half shall be applied as if this section had not been enacted.

107. In proceedings before justices under this act any railway company or other body corporate may appear by any member of their board of directors or council, or by any officer authorized in writing under the hand of any director or member of the council of the company or body.

108. If any party feels aggrieved by the dismissal of his complaint by justices, or by any determination or adjudication of justices with respect to any penalty or forfeiture under this act, he may appeal therefrom, subject to the conditions and regulations following:

(1.) The appeal shall be made to some court of general or quarter sessions for the county or place in which the cause of appeal has arisen, holden not less than fifteen days and not more than four months after the decision of the justices.

(2.) The appellant shall, within three days after the cause of appeal has arisen, give notice to the clerk of the petty sessional division for which the justices act whose decision is appealed from, of his intention to appeal, and of the grounds thereof.

(3.) The appellant shall immediately after such notice enter into a recognizance, before a justice of the peace, with two sufficient sureties, conditioned personally to try such appeal, and to abide the judgment of the court thereon, and to pay such costs as may be awarded by the court.

(4.) The court may adjourn the appeal and may make such order thereon as they think just. But nothing in this section respecting appeals shall affect any enactment relative to appeals in cases of summary convictions or adjudications in the city of London or the metropolitan police district.

109. For the purposes of proceedings under this act, or any order of the privy council or order or regulation of a local authority thereunder, every offense against this act or any such order or regulation shall be deemed to have arisen, either in the place in which the same actually was committed or arose, or in any place in which the person charged or complained against happens to be.

Protection of persons in execution of act.

110. An action or proceeding shall not lie against any person acting or intending to act under the authority or in the execution or in pursuance of this act for any alleged irregularity or trespass or other act or thing done or omitted by him under this act, unless notice in writing (specifying the cause of the action or proceeding, and the name and residence of the intending plaintiff or prosecutor, and of his attorney or agent in the matter) is given by the intending plaintiff or prosecutor to the intended defendant one month at least before the commencement of the action or proceeding, nor unless the action or proceeding is commenced within four months next after the doing of such damage has ceased; and any such action shall be laid and tried in the county or place where the cause of action arose, and not elsewhere.

111. In any such action the defendant may plead generally that the act or thing complained of was done or omitted by him when acting or intending to act under the authority or in the execution or in pursuance of this act, and may give all special matter in evidence.

112. On the trial of any such action the plaintiff shall not be permitted to go into evidence of any cause of action not stated in his notice.

113. The plaintiff in any such action shall not succeed if tender of sufficient amends is made by the defendant before the commencement of the action; and in case no tender has been made the defendant may, by leave of the court in which the action is brought, at any time pay into the court such sum of money as he thinks fit, whereupon such proceeding and order shall be had and made in and by the court as may be had and made on the payment of money into court in an ordinary action.

114. If in any such action the plaintiff does not succeed in obtaining judgment, the defendant shall receive such full and reasonable indemnity as to all costs, charges, and expenses incurred in and about the action as may be taxed and allowed by the proper officer, subject to review; and though a verdict is given for the plaintiff in the action, he shall not have costs against the defendant unless the judge before whom the trial is had certifies his approval of the action and verdict.

115. When any such action or proceeding is defended under the direction or with the approval of the local authority, the costs, charges, and expenses incurred in and about the same, by or on behalf of the defendant and payable by him, and any damage or other money recovered against or payable by him in or in consequence of such action or proceeding, shall be deemed expenses incurred by the local authority in pursuance of this act and shall be defrayed accordingly.

PART X.—SCOTLAND.

116. The provisions of this part of this act shall extend to Scotland only, and shall have effect in substitution for the provisions of the preceding parts of this act, when so expressed or implied, and otherwise shall have effect in addition to the provisions thereof.

117. For the purposes of this act the respective districts, authorities, rate, and officers described in that behalf in the ninth schedule to this act shall be the district, the local authority, the local rate, and the clerk of the local authority.

118. The commissioners of supply in every county shall meet and nominate not fewer than four or more than fifteen of their number to act on the county board for the purposes of this act, and shall intimate to the lord lieutenant of the county and the convener of the county the number and names of the persons so appointed.

The clerk of supply in each county shall call a meeting of the occupiers of agricultural subjects in such county, valued in the valuation roll in force for the time at one hundred pounds and upwards, and of occupiers of such subjects of which they are owners valued in the valuation roll at fifty pounds and under one hundred pounds; and such meeting shall be called by advertisement in one or more newspapers circulating in the county for the same day as, or for a day not later than eight days after the meeting of the commissioners of supply, and such advertisement shall specify the time and place of such meeting, and the clerk of supply shall be clerk to such meeting; and the meeting shall nominate from among such occupiers, and owners and occupiers, a number of persons equal to those nominated by the commissioners of supply; and the meeting shall also name a convener, who shall intimate the names of the persons so nominated to the convener of the county, and shall have power to call similar meetings by such advertisement, when occasion shall require; and in the event of such election not being intimated to the convener of the county within fifteen days from the date of such meeting, it shall be lawful to the lord lieutenant to nominate from among such occupiers, or owners and occupiers, such number of persons, and intimate the same to the convener of the county.

Any such nomination and intimation made for the purposes of any act repealed by this act shall continue to have effect for the purposes of this act.

Vacancies from time to time happening by death, resignation, or otherwise among the members of the local authority shall be filled up by the authority and in the manner by and in which the members vacating office were respectively nominated.

The persons nominated as in this section provided, and the lord lieutenant of the county, the convener of the county, and the sheriff of the county (or in his absence such one of his substitutes within the county as he directs by writing under his hand) for the time being, shall constitute the local authority; five shall be a quorum of the local authority.

As far as not otherwise provided by this act, such local authority shall have all the powers conferred on the local authority by this act, and shall have power to elect a chairman, specify a quorum, and make all regulations necessary for carrying the purposes of this act into effect.

The chairman of the local authority, and in default of him the convener of the county, and in default of him any three members of the local authority, may at any time call a meeting of the local authority, to be held at such time and place as he or they may fix, and the local authority may adjourn as they from time to time think fit.

119. Part VII of this act shall have effect as if section ninety of the public health (Scotland) act, 1867, were thereby applied, instead of section seventy-five of the local government act, 1858; and in the said section ninety the local authority and local rate under this act shall be substituted for the local authority and the assessment therein mentioned.

120. The local authority in a county shall from time to time give notice to the commissioners of supply of the sums necessary to be provided under the provisions of this act by means of the local rate; and the amount so intimated shall be assessed and collected by the commissioners of supply according to the real rent of lands and heritages as appearing on the valuation roll in force for the year, who shall pay over the same to the local authority.

The local authority in a burgh shall in like manner assess and collect the amount required to be raised by local rate within such burgh.

All such assessments shall be payable one-half by the proprietor and one-half by the tenant, but may be collected wholly from the tenant, who shall in that case be entitled to deduct one-half thereof from the rent payable by him to the proprietor, who shall in that case be entitled to relief against the tenant for one-half of the assessment; and for the purposes of the provisions of this act relative to any balance of funds remaining over from any assessment, the words "local rate" shall in Scotland mean the poor rate.

All the provisions in regard to the recovery of assessments in the act of the session of the twentieth and twenty-first years of Her Majesty (chapter 72), "to render more effectual the police in counties and burghs in Scotland," are hereby incorporated in this act, as far as the same are not inconsistent with the provisions of this act.

121. In the case of a county, a printed copy of an order or regulation of the local authority, purporting to be certified to be a true copy by the clerk of supply, shall be received in proof.

122. The terms "justice" and "justices" shall include any magistrate having jurisdiction under the summary-procedure act, 1864.

123. In the event of any person refusing or delaying to comply with the order of a local authority, the local authority may give information thereof to the procurator-fiscal of the county or burgh, who may apply to the sheriff for a warrant to carry such order into effect, and such warrant may be executed by the officers of the court in the usual way.

124. All judicial powers given to justices and quarter-sessions, or to magistrates in boroughs, by this act, may also be exercised by the sheriff of the county or the sheriff subsitute.

125. Notice of appeal and of the grounds thereof shall be given to the clerk of the peace of the county.

126. For the purposes of this act the burgh of Maxwelltown shall be held to be a part of the stewartry of Kirkcudbright, and not of the parliamentary burgh of Dumfries.

SCHEDULES.

The first schedule relates to acts repealed.

The second schedule refers to the local authorities, &c., in England.

District of local authority.	Description of local authority of district set opposite name.	Local rate.	Clerk of local authority.
Counties except the metropolis.	The justices in general or quarter sessions assembled.	The county rate, or rate in the nature of a county rate.	Clerk of the peace.
The metropolis (subject to the provisions of this act respecting the city of London and the liberties thereof).	The metropolitan board of works.	Rate or fund applicable to the payment of the general expenses of the board.	The clerk of the metropolitan board of works.
Boroughs	The mayor, aldermen, and burgesses acting by the council.	The borough fund or borough rate.	Town clerk.
	Where the borough is not subject to the act of the session of the fifth and sixth years of the reign of King William the Fourth, chapter seventy-six, the commissioners or other body maintaining the police therein.	The rate applicable by the commissioners or other body to the maintenance of the police.	Clerk of the commissioners or other body.
District of local board of Oxford.	The local board..........	Rate leviable by the local rate.	Clerk of the local board.

The third schedule contains regulations respecting committees and subcommittees:

"1. A committee formed by a local authority may consist wholly of members of the local authority, or partly thereof, and partly of such other persons being rated occupiers in the district and qualified in such other manner as the local authority determine.

"2. A committee of a local authority and a subcommittee of an executive committee may elect a chairman of their meetings.

"3. If no chairman is elected, or if the chairman elected is not present at the time appointed for the holding of a meeting, the members then present shall choose one of their number to be chairman of the meeting.

"4. A committee or subcommittee may meet and adjourn as they think proper.

"5. Every question at a meeting of a committee or subcommittee shall be determined by a majority of votes of the members present and voting on the question, and in case of an equal division of votes the chairman shall have a second or casting vote."

The fourth schedule refers to regulations that may be applied to the landing, movement, and disposal of foreign animals:

"1. These regulations are to have effect with respect to those foreign animals to which they are from time to time applied by order of the privy council.

"2. Those foreign animals are to be landed only at parts of ports defined by special orders of the privy council for the several ports as places where foreign animals may be landed.

"3. They are to be landed in such manner, within such times, and subject to such supervision and control as the commissioners of customs from time to time direct.

"4. The owner, consignee, or other person landing them is either before landing them or within twelve hours after landing them, at his own expense, to mark them as follows: In case of cattle, by clipping the hair off the end of the tail, and in such further manner (if any) as the privy council from time to time prescribe, and in case of other animals in such manner as the privy council from time to time prescribe.

"They are not to be moved from the place of landing or lairs adjacent thereto, approved by the privy council, except as follows:

"(*a.*) After the expiration of twelve hours from the time of landing or such other period as the privy council from time to time prescribe.

"(*b.*) On a certificate from the veterinary inspector appointed in this behalf by the commissioners of customs, certifying that they are free from contagious or infectious disease.

"6. They are not to be moved alive out of the part of the port of landing from time to time defined in that behalf by the privy council.

"7. Notwithstanding anything in these regulations, where a vessel comes into port having on board foreign animals maimed or injured on the voyage, the owner, consignee, or other person in charge thereof, or the master of the vessel, shall, if directed by the veterinary inspector aforesaid, or may, if he thinks fit, slaughter those animals any of them immediately on their being landed, but the carcass, hide, skin, hair, wool, horn, hoof, or offal of any such animal, or any part thereof, is not to be moved from the place of landing, or some lair or slaughter-house adjacent thereto approved by the privy council, without a certificate from the veterinary inspector aforesaid, certifying that it is not likely to introduce or spread contagious or infectious disease."

The fifth schedule has reference to the tolls and dues levied in the metropolitan market after opening of foreign cattle market.

Sheep, per head	Five farthings.
Beasts, per head	Sixpence.
Calves, per head	Threepence.
Pigs, per head	Five farthings.

The sixth schedule contains "Rules with respect to infected places."

PART I.—CATTLE-PLAGUE.

1. The rules of this part of this schedule are to have effect with respect to infected places as regards cattle-plague.

2. No animal is to be moved alive out of an infected place.

3. Any hide, skin, hair, wool, horn, hoof, or offal of any animal, or any part thereof, is not to be moved out of an infected place without a license signed by an officer of the local authority appointed to issue licenses in that behalf, certifying either that the thing moved has not formed part of an animal affected with cattle-plague; or if an animal that has been in the same shed or stable, or in the same herd or flock, or in contact with an animal so affected, or that the thing moved has been disinfected.

4. The carcass of an animal, or a single portion of raw meat weighing more than twenty pounds, is not to be moved out of an infected place without a license signed by an officer of the local authority appointed in that behalf certifying that the carcass or meat moved is not the carcass or part of the carcass of an animal affected with the cattle plague.

5. Any dung of animals, and any hay, straw, litter, or other thing commonly used for food of animals, or otherwise for or about animals, is not to be moved out of an infected place without a license signed by an officer of the locality appointed in that behalf, certifying that the thing moved has not been in contact with or been used for or about any animal affected with cattle plague, or that it has been disinfected.

PART II.—SHEEP-POX.

1. The rules of this part of this schedule are to have effect with respect to infected places as regards sheep-pox.

2. No sheep is to be moved alive out of an infected place.

3. Any skin, wool, horn, or hoof of any sheep, or any part thereof, is not to be moved out of an infected place without a license signed by an officer appointed by the local authority to issue licenses in that behalf, certifying that the thing moved did not belong to any sheep forming part of a flock affected with sheep-pox, or to any sheep that has been on a place in which that disease existed.

4. Sheds and places used by sheep affected with sheep-pox are forthwith, after being so used, to be cleansed and disinfected.

The seventh schedule contains "pleuro-pneumonia rules."

1. These rules are to have effect with respect to any field, stable, cow-shed, or other premises infected by pleuro-pneumonia.

2. Cattle affected by pleuro-pneumonia are not to be moved from such field, stable, cow-shed, or other premises, or from any land or building contiguous thereto, in the same occupation, except for immediate slaughter, and according to regulations to be from time to time made by the local authority for insuring such slaughter.

3. Other cattle are not to be moved from such field, stable, cow-shed, or other premises, or from any land or building contiguous thereto in the same occupation, except for immediate slaughter, without a license signed by an officer of the local authority appointed to issue licenses in that behalf, certifying that the cattle moved are not affected with pleuro-pneumonia, and have not been in the same shed or herd or in contact with cattle so affected.

4. Sheds and places used by cattle affected with pleuro-pneumonia are forthwith after being so used to be cleansed and disinfected to the satisfaction of the local authority.

The eighth schedule gives the forms to be used by the inspector.

(1.)

Declaration of disease.

[The contagious diseases (animals) act, 1869.]

I, A. B., of ———, the inspector appointed by ———, being the local authority for the county of ———, hereby declare that I have this day found cattle plague [*or* pleuro-pneumonia *or* sheep-pox] to exist in the following field, stable, cow-shed, or other premises (that is to say) [*here describe the place where the disease is found*].

Dated this —— day of ———, 18——.

(Signed) A. B.

(2.)

Notice of declaration to occupiers

[The contagious diseases (animals) act, 1869.]

To C. D., of ———:

I, A. B., of ———, inspector appointed by ———, being the local authority for the [county] of ———, hereby give you notice, as the occupier of the following field, stable, cow-shed, or other premises (that is to say), [*here describe the place where the disease is found*], that I have made a declaration, a copy whereof is indorsed on this notice [*copy of declaration as filled up and signed to be indorsed*], and that in consequence thereof * the field, stable, cow-shed, or other premises aforesaid, with all lands and buildings contiguous thereto in your occupation, have become and are an infected place, and that the same will continue to be an infected place * until the determination and declaration relative thereto of the local authority, as provided for in section of —— of the above-mentioned act [*or in case of pleuro-pneumonia omit the part between the asterisks, and insert* the pleuro-pneumonia rules of the above-mentioned act will have effect in relation to the field, stable, cow-shed, or other premises aforesaid].

Dated this —— day of ———, 18—.

(Signed) A. B.

(3.)

Notice of declaration to adjoining occupiers.

[The contagious diseases (animals) act, 1869.]

To E. T., of ———:

I, A. B., of ———, the inspector appointed by ———, being the local authority for the [county] of ———, hereby give you notice that I have made a declaration, a copy whereof is indorsed on this notice [*copy of declaration as filled up and signed to be indorsed*], and that in consequence thereof the field, stable, cow-shed, or other premises therein described, with all lands and buildings contiguous thereto in the same occupation, have become and are an infected place, and the same will continue to be an infected place until the determination and declaration relative thereto of the local authority, as provided for in section —— of the above-mentioned act. And I hereby require you, as an occupier of lands and buildings adjoining to such infected places, part [or the whole] whereof lies within one mile of the boundaries of the infected place, to take notice that in consequence of the declaration aforesaid the rules of the said act with respect to infected places will, until such determination and declaration of the local authority as aforesaid, apply and have effect to and in respect of the land and buildings of which you are occupier as if the same were actually within the limits of the infected place.

Dated this —— day of ——, 18—.

(Signed) A. B.

The ninth schedule refers to the local authorities, &c., in Scotland.

District of local authority.	Description of local authority of district set opposite name.	Local rate.*	Clerk of local authority.
Counties including any town or place which does not return or contribute to return a member to Parliament.	The persons appointed as provided in Part X of this act.	....	Clerk of supply.
Burghs which return or contribute to return a member to Parliament.	The magistrates and town council.	....	Town clerk.

* Rate appointed to be levied in Part X of this act.

Several amendments and modifications to the above law have been made since its enactment, among which the following has the most important bearing upon cattle exported from the United States:

IV.—OTHER FOREIGN COUNTRIES.

11. In relation to foreign animals other than those brought from the Channel Islands and the Isle of Man, if and as long as, from time to time, the privy council are satisfied, with respect to any foreign country, that the laws thereof relating to the importation and exportation of animals, and to the prevention of the introduction or spreading of disease, and the general sanitary condition of animals therein, are such as to afford reasonable security against the importation therefrom of diseased animals, then, from time to time, the privy council, by general or special order, shall allow animals, or any specified kind of animals, brought from that country, to be landed, without being subject, under the provisions of this schedule, to slaughter or to quarantine, and may for that purpose alter or add to those provisions, as the case may require; but every such order shall forthwith, after the making thereof, if Parliament is then sitting, and if not, then forthwith after the next meeting of Parliament, be laid before both houses of Parliament.

CONTAGIOUS PLEURO-PNEUMONIA.

Third Report of Charles P. Lyman, F. R. C. V. S.

Hon. WILLIAM G. LE DUC,
Commissioner of Agriculture:

SIR: Although my recent examination of American cattle, as landed and slaughtered in England, had for its chief object the detection of the contagious pleuro-pneumonia so frequently reported by the English governmental authorities as existing among them, and the subsequent location, as nearly as possible, in the United States, of the herds from which these animals had been taken, I made my last report to you upon this subject before having had sufficient opportunity to examine as thoroughly as seemed to me desirable the details connected with this direct investigation, because I considered that, incidentally, matters of the greatest importance connected with our cattle export trade had come to my knowledge, and that under the circumstances it was very important that these facts should come to the knowledge of Congress early in the session, so that, if they deemed them of as much importance as they seemed to me, they might have time to take such action as they deemed necessary.

Therefore the second report was made, and I was obliged to content myself, at that time, with the statement that if pleuro-pneumonia existed in the West, or if there were diseased cattle in or about the points through which the animals passed on their journey eastward, the information already possessed would, after a little further time, insure its location. That time I have now had, and in this report I intend to discuss simply the facts bearing upon these two points of the inquiry. First, by tracing back the condemned animals, so far as I have been able, from England to the States wherein they were raised, and to show what likelihood there is that contagious pleuro-pneumonia exists in any of these States. Second, by submitting to you the report of Dr. W. F. Whitney, the microscopist, whose services were engaged for the special purpose of examining the diseased portions of lung brought home by me from Liverpool; and, third, by discussing, in addition to this, which may be called the direct testimony in the case, the circumstances connected with the marketing, transporting by rail, and shipping of cattle through our uninfected districts and ports to England; *i. e.*, that part of the matter which may be called the indirect testimony, or in reality a putting together of *facts* connected with this shipping business, and drawing from them what seems to me to be reasonable deductions.

The lungs condemned in my presence were six in number, and were from animals coming from Boston to Liverpool in the following named steamers, and in the numbers given: Iberian, one; Victoria, two; Brazilian, two; and from New York to Liverpool in the steamer Aleppo, one.

The history of these animals, as I have been able to learn, is as follows: Mr. Smith, butcher, bought of Mr. George Roddick, cattle salesman at Liverpool, 194 bullocks from the cargo of the steamer Brazilian, landed at Birkenhead, July 7, 1880. These animals were consigned to the salesman by Messrs. J. & C. Coughlin, of London, Ontario, Canada, who bought them in Boston, to which place they had been shipped direct from the Chicago market, via the Grand Trunk Railway of Canada, to Buffalo; thence, via the New York Central, to Albany; thence, via the Boston and Albany, to Boston. The lot consisted of steers from the States of Missouri, Iowa, and Illinois.

Mr. Alfred Dawson, butcher, bought of Mr. George Roddick, cattle salesman at Liverpool, several bullocks from the cargo of the steamer Victoria, landed at Birkenhead, July 15. These animals were consigned to the salesman by Mr. Timothy Coughlin, London, Canada, who bought them in Boston, to which place they had been shipped direct from the Chicago market, via the Grand Trunk Railway of Canada, to Buffalo; thence, via the New York Central, to Albany; thence, via the Boston and Albany, to Boston. This lot, as in the last case, consisted of steers from Missouri, Iowa, and Illinois.

Since leaving Liverpool I am advised that up to the 21st of November seven more animals were condemned, as follows: On September 5, from the cargo of the steamer Palestine, three animals. These were from a lot consigned to Messrs. Utley and Sons, of Liverpool, by Messrs. T. & F. Utley, of Boston; 44 of them were Missouri and 100 Iowa animals. They were bought in the Chicago market and came to Boston, via Buffalo and Albany, over the Grand Trunk, New York Central, and Fitchburg Railroads.

On November 9, from the cargo of the steamer Victoria, one animal. This was from a lot consigned to Mr. Ramsden, cattle salesman, Liverpool, by Messrs. Wales & McLeavitt, of Boston, all of them being Illinois steers, bought in Chicago market and shipped to Boston over the Michigan Central, Grand Trunk, Vermont Central, and Fitchburg Railroads.

On November 18, from the cargo of the steamer Bohemian, one animal. This was from a lot consigned to Mr. Hewlett, cattle salesman, Liverpool, by Mr. William Hawksworth, Brighton, Mass. They were Illinois steers, one-half purchased in Albany, coming to Boston via Boston and Albany Railroad. They had been brought to Albany from Chicago over the Lake Shore and Michigan Southern route. The other half were bought in Brighton market, Boston, and had been brought from Chicago via Grand Trunk, New York Central, and Fitchburg Railroads.

On November 18, from the cargo of the steamer Brazilian, one animal. This was from a lot consigned to Mr. William Carroll, Liverpool, by Messrs. Hathaway & Jackson, of Boston, and were all Ohio cattle, bought especially for this shipment in that State, and were shipped via Buffalo, and from there over the New York Central to Albany, thence over the Fitchburgh Railroad to Boston.

On November 21, from the cargo of the steamer Iowa, one animal. This was from a lot consigned to Messrs. Utley & Sons, Liverpool, by Messrs. T. & F. Utley, of Boston. Fifteen or twenty of them were Ohio cattle, and came direct from London, Ohio, by way of Buffalo, Albany, and Fitchburg, to Boston. The remainder were Missouri and Illinois steers, and came from Chicago by Grand Trunk Road.

With one exception this traces, I believe, all the condemned animals that have arrived at Liverpool from Boston from July 7 to November 21, 1880. (The one not traced was from the cargo of the steamer Iberian, landed July 14; the reason for this will be described further on in this report.) From it will be seen that the native States of the condemned animals are Missouri, Iowa, Illinois, and Ohio; that the only markets through which they have passed are Chicago, Buffalo, Albany, and Boston; that the lines of rail that have been used are the Lake Shore and Michigan Southern, Michigan Central, Grand Trunk line of Canada, New York Central, Vermont Central, Boston and Albany, and the Fitchburg, or, as it is sometimes called, the Hoosac Tunnel route.

Cattle from the United States, upon being landed in Liverpool or at Birkenhead, are driven into stables erected for the purpose upon the wharves upon which they are landed, and are tied up in rows facing each other between which there is a passage way. After they have remained here, resting and feeding for at least twelve hours, they are examined by the veterinary inspector of the port, and, after they have passed this examination the salesman to whom they are consigned is at liberty to sell them, and the butcher who buys them, to drive them into the shambles, also situated upon the same wharf, where they are killed under the restriction that all *lungs* must be laid aside until they have been examined by the inspector, when those not condemned may be disposed of in any way that the owner sees fit. This examination is made by clasping, one at a time, the lungs between both hands, and in this position passing them over their entire surface, when, if anything peculiar is *felt*, it is cut down upon and examined. In this way the slightest variation from the normal becomes at once apparent; in fact, it is surprising how quickly the smallest change in them may be located. In this connection I also wish to have the fact borne in mind that in no one of these cases condemned in my presence did the inspector discover the disease before the animal was killed, although every animal was closely inspected in the way described, and in no one case was there any appearance about any one of these condemned animals that caused the slightest question to be raised as to its healthfulness, notwithstanding he had but very recently passed the scrutiny both of the port inspector and the butcher who had bought him; nor was there one of them that was not fully up to the average of his fellows in flesh.

The microscopic appearances of these six lungs in their fresh state were as follows:

Brazilian No. 1.—This lung contained, in about its center, a large, hardened object that could be both seen and felt, and would measure, perhaps, about six inches through its largest diameter. This, upon being cut into, appeared to be an abscess containing nothing but a pure, rather thick, creamy pus, and, although any portion of dead tissue that might be contained within this cavity was thoroughly searched for, nothing of the sort could be found. The cavity was surrounded by what seemed to be a rather thick cartilaginous wall, this again by a considerable amount of "marbled" tissue in which the parenchymæ was of an even pinkish color, with the interlobular thickening well marked, white, hard, and firm. This, in its turn, passed almost imperceptibly, the parenchymæ becoming gradually more and more areable, and the interlobular thickening growing narrower and narrower into the healthy lung tissue surrounding the whole.

Brazilian No. 2.—This lung, with its fellow, upon its surface, presented to the eye no indication of disease, but upon being handled in the way described above, several small nodules within its substance at once became apparent; these, upon being cut down upon, in the one lung disclosed the unmistakable lesions of tuberculosis, and in the other, where these indurations felt were much fewer and smaller, the nodules showed the peculiar lesions upon which it was condemned. There were several small nodules situated in the periphery of the extreme posterior portion of the large lobe of the right lung, the larger of which was about one-half inch in diameter; in its center there appeared to be a cheesy deposit; this was surrounded by a very thin layer of a thin grayish-colored pus; outside this a very thin membrane; outside this again, a very limited amount of marbled tissue, which, near the center, was well marked, but more indistinct toward its outer margin. Of these nodules there were some four or five perfectly isolated from one another, but all being, to the unaided eye, of the same description.

Victoria lungs.—There were two pairs of these, condemned from the same lot at the same examination. One lung showed one and the other three indurated spots upon which the lungs were condemned. The largest of these "spots" was about the size of an English walnut, and was situated exactly at the root of the lung; the remaining three were situated in various isolated positions in the substance of the lung. Upon being cut down upon they all exhibited the same general appearance as those of the Brazilian No. 2 lung already described, except that in the case of the largest specimen there was a fair amount of sub-pleural thickening, although there had been no adhesion between these surfaces. Of this portion of lung Dr. Whitney says: "The size and appearance of the diseased portion after a clean cut had been made through it is represented on Plate IV. The disease involves about one-half dozen lobules, representing about 50 to 75 cubic centimeters in bulk (Plate IV *a.*) These are quite homogeneous in appearance, and within them are seen one or two small irregularly rounded cavities containing a cheesy material. The interlobular tissue between them and the more healthy portion of the lung (Plate IV int. tis.) is very thick and dense." In its fresh state this cheesy deposit was surrounded by a thin layer of what appeared to be a thin, grayish pus; this again by a thin membranous wall, this by the "marbled" tissue, limited in extent, and surrounded on three sides by healthy tissue.

Aleppo lung.—The lung from which this specimen was taken was from a bullock killed in Liverpool July 23, and which the inspector said he considered a fine specimen of contagious pleuro-pneumonia, and, as will be seen by reference to Plate VII, which is copied from a painting made by a leading firm of photographers in Liverpool from the lung itself, on the same day upon which it was taken from the animal, and is a most perfect representation of its appearance, has very much the look of that disease; indeed so close is its resemblance that no one would be warranted in saying that it was not it until a most thorough examination had been made of the specimen.

Plate VII*a* represents the point at which adhesion had taken place between the two pleural surfaces, and at which, upon being broken down by the fingers, there was left a small rounded eminence of loosely formed connected tissue, *b*, the diseased nodule showing the discolored lobules and the greatly thickened interlobular tissue; *c c*, healthy lung tissue.

After getting this portion of lung to Boston, another cut was made into the nodule parallel to the first, and at a point directly through the center at *a*. The surface thus exposed had a very different appearance. At about the center of the nodule was a small, irregularly shaped cavity surrounded by a mass of material having a grayish cheesy look; in fact giving precisely the appearance noticed in all of the specimens except the Brazilian No. 1.

Iberian.—This specimen was not retained by me, nor were any inquiries made about it that would enable me afterwards to trace the animal in the United States, because at the time it was discovered by Mr. Moore, the inspector, and shown to me, I did not think that there was the slightest indication of pleuro-pneumonia about it, and so told Mr. Moore, who, I thought, agreed with me at the time, and so the lung was not retained. Two days afterwards, however, I found, much to my surprise, that it had been condemned and reported to the London authorities as having been a case of pleuro-pneumonia. My recollection of its appearance is that it contained seven or eight nodules isolated from one another, consisting of a small cheesy deposit no larger than a pea, surrounded by a thin membrane, and showed *no* marbled tissue whatever.

In addition to this description I may say that every specimen described in this report was seen and examined by Inspector Professor Duguid, of the London office, and pronounced by him to be undoubtedly pleuro-pneumonia. Also that each and every one of them were shown in August last to Professor Williams, who declared that, in his opinion, none of them were pleuro-pneumonia unless it was the Aleppo specimen, upon which he would give no opinion without a chance for a more minute examination of it.

MICROSCOPIC EXAMINATION.

All of the specimens of lungs which I have endeavored to describe were given by me to Dr. W. F. Whitney, of Boston, Mass., curator of the Warren Anatomical Museum, and assistant in pathological anatomy in the medical department of Harvard University, who made a most thorough microscopical examination of them, and whose report upon the subject I have the honor to herewith submit:

BOSTON, MASS., *December* 30, 1880.

CHAS. P. LYMAN, F. R. C. V. S.,
Veterinary Surgeon, Department of Agriculture:

DEAR SIR: At your request I have examined the portions of lungs coming from American cattle killed in Liverpool, said to be affected with contagious pleuro-pneumonia.

From a careful study of those specimens in comparison with others obtained from an unquestionable case of that disease, from the description of its characteristics as given by Williams, Yeo, Roy, and others, it appears that the changes seen in those specimens are caused by *chronic inflammatory processes, especially of the interstitial tissue, in some cases combined with miliary tuberculosis, which, reasoning from analogous processes found in the human lung, are not contagious.*

In proof of the above statement I send you herewith the preparations upon which it is based, with drawings, and in explanation of them will call your attention, first, to the relations of the healthy lung, then to the changes seen in a lung affected with contagious pleuro-pneumonia, and, finally, to the manner in which the changes seen in the specimens sent for examination differ from those of that disease.

The lungs of cattle differ from those of man, in that each lobe is distinctly subdivided into numerous lobules (each occupying the space of from 10 to 30 cubic centimeters) joined to each other by fine bands of connective tissue, which also forms the walls of extensive lymph spaces, connecting on the one hand with those lying in the pleura, and on the other with the lymph canals, which nearly surround the blood-vessels accompanying the bronchus into the lung tissue. These relations are shown in the preparation marked "normal lung of bullock, lymph spaces injected with blue," and from which Plate I has been drawn. Fig. 1 represents a section through the whole of one and part of an adjoining lobule with the uniting bands of connective tissue inclosing lymph spaces. The extreme thinness of this band is especially to be noticed. The walls of the alveoli, which form the tissue proper (Fig. 1, lung tis.) are fine, and have a slightly wavy crinkled outline, and in them are a few scattered lymph and epithelioid cells. One or more small bronchi are usually to be found in each lobule. A more highly magnified view of one of these is represented in Fig. 2. In this can be distinguished three coats, a mucous or inner coat, a muscular or middle coat, and an external coat. The mucous coat (Fig. 2, muc. ct.) is formed by a layer of columnar epithelium, its inner surface resting upon a narrow zone of connective tissue (submucous coat) which is thrown into folds when the bronchus is contracted. The muscular coat (Fig. 2, mus. ct.) is composed of unstripped fibers arranged concentrically. Outside of this is the external coat, composed for the greater part of a collection of round cells, probably of a lymphoid character, separating it from the accompanying artery and vein (Fig. 2. art. and v.), which are almost surrounded (in some places entirely so) by the lymph canals (Fig. 2, lym. sp. c.).

In the diseased lungs the changes occurring in the connective tissue, including the lymph spaces, in the alveoli with their walls, and in the bronchi, will be considered and compared with each other.

CONTAGIOUS PLEURO-PNEUMONIA.

Contagious pleuro-pneumonia presents three stages (designated as A, B, and C), dependent upon the degree to which these tissues are affected.

In the earliest or stage A (see preparation marked contagious pleuro-pneumonia, stage A, from which Plate II has been drawn) the most marked changes are in the lymph spaces. Those in the pleura are in a great measure obliterated by the growing together of its two layers, and such as remain (Plate II, lym. sp. A) are filled with young round cells, leaving only a narrow passage close to the wall. The interlobular spaces (Plate II, lym. sp. B) are filled with a semi-gelatinous fluid, which in hardened specimens becomes coarsely fibrillated and in which are a few scattered round (lymphoid) cells. The bands of connective tissue forming the walls of the lymph spaces are but slightly thickened. In the lymph canals about the vessels are a few clumps of lymph cells. The opening of the canal is in general free (Plate II, Figs. 1 and 2 lym. sp. c.).

The walls of the alveoli have no longer a crinkly outline, but a slightly stiff appearance, giving the alveoli a much rounder look. This is partly due to an engorgement of the vessels and partly to an increase of lymph and epithelioid cells in and upon the walls (Plate II, Fig. 1, lung. tis.).

In the small bronchi the changes are confined to the mucous coat (Plate II, muc. ct.), which is thickened from a proliferation of the epithelium, the cells next the free surface having a tendency to degeneration as shown by a slight detritus.

In the second stage (see preparation contagious pleuro-pneumonia, stage B) the exudation in the interlobular lymph spaces is firmer and there are a greater number of cells. The walls of the spaces are but little changed from the preceding stage. The canals about the vessels are more extensively filled with cells, and here and there a vessel is plugged.

Most of the alveoli are filled with an exudation, in places resembling that in the interlobular lymph spaces in stage A, and similar to that found in croupous pneumonia of the human lung, in places consisting entirely of lymph and epithelioid cells. The contents of certain of the alveoli take coloring matter badly, showing that a degeneration has taken place in the cells.

The mucous membrane of the bronchus is much thickened, and in the opening of the tube is to be seen detritus of exfoliated and degenerated epithelium.

In the third stage (see preparation marked contagious pleuro-pneumonia, stage C, and from which Plate II has been drawn) the interlobular exudation is a little firmer and more fibrillated, the original walls of the lymph spaces are still to be distinguished as moderately thickened bands (see Plate III, Fig. 1 lym. sp. B). The canals about the vessels (Fig. 1, lym. sp. C) are completely filled with lymphoid cell, the vessels are usually plugged, and a more or less extensive hemorrhage may take place into the surrounding tissue (see Fig. 1, art).

The alveoli are filled with lymph and epithelioid cells, in many cases degenerated and retracted from the walls into little granular clumps. The walls themselves are much thickened in some places from a hypertrophy of the fibers of unstripped muscular tissue, which is normally present in small amount, especially at the place where the bronchus passes into the alveoli (see Fig. 2, mus. hyp.).

The bronchi in this stage are only distinguished with difficulty, and the explanation lies in the fact that the mucous membrane has become entirely degenerated and cast off from the walls (see Fig. 1, br. muc. ct.), the cells reduced to a detritus, which, together with lymph and blood cells, completely occlude the opening, leaving no characteristics by which to distinguish it from any other plugged vessel.

Upon grouping together the appearances as presented in the different stages, it is manifest that the lymph spaces are at first filled with a coagulable material, and the increased density of this in the later stages of the disease is due to an increase in the number of cell elements and not to a material increase in the thickness of the walls of the spaces. With the increasing firmness of this exudation the alveoli are filled with cells and exuded material, as are also the lymph canals about the vessels; and when this has reached a marked degree, the mucous coat of the bronchus, which in the earlier stages of the disease has taken part by a proliferation of its epithelium, is cast off and the tube is filled with its detritus and an exudation similar to that in the neighboring lymph canals. The muscular coat of the bronchus resists longer and can be clearly distinguished after the mucous coat is destroyed. With this filling of the lymph canals the vessels are occluded and hemorrhage may take place into the surrounding tissue.

DISEASED LUNGS FROM LIVERPOOL.

The one first examined was marked "Steamer Victoria, from Boston, July 19, 1880, Liverpool," and will be referred to as the Victoria lung.

The size and appearance of the diseased portion after a clean cut had been made through it, is represented in Plate IV. The disease involves about one-half a dozen lobules, representing about 50-75 C. C. in bulk (Plate IV, A). These are quite homogeneous in appearance, and within them are seen one or two small, irregularly rounded cavities, containing a cheesy material. The interlobular tissue between them and the more healthy portion of the lung (Plate IV, B) is very thick and dense (Plate IV, int. tis.).

The whole has a resemblance to contagious pleuro-pneumonia in that the lobules and interlobular tissue are involved, but differs in the small amount of tissue implicated when considered in relation to the *degree to which* the interlobular tissue is affected. What the cause of these changes is will be understood from the preparation marked S. S. Victoria, &c., and from which Plate V has been made.

Looking first at the interlobular spaces it will be seen that there is no longer any trace of the lymph spaces, but that the lobes are joined by a firm band of connective tissue, rich in young cells (Plate V int. tis.). The earlier stages of this are seen in that part of the preparation which shows no changes to the unaided eye (this is not shown in the drawing), and there it appears that this tissue results from a thickening of the walls of the lymph spaces. Later, when this has become dense, an accumulation of cells takes place in the contracted spaces and the whole becomes fused into the firm mass shown in the drawing.

From the action of this connective tissue the alveoli are compressed and the walls are slightly thickened from the presence in them of large numbers of young cells. There is but little tendency, however, to exudation or accumulation of cells within the alveoli.

The greatest changes within the lobules are seen about the bronchi and their accompanying vessels. It will be remembered that there is normally a narrow zone of connective tissue, rich in cells, surrounding the bronchus and separating it from the adjacent vessels. These cells have proliferated to such an extent as to form a wide band about the bronchus, involving the blood vessels, which are, however, still pervious, but compressing the lymph canals to such an extent that their presence is with difficulty made out. The coats of the bronchi are also affected, but in the reverse order from what they are in contagious pleuro-pneumonia, viz: The muscular coat has almost disappeared (see Plate V, mus. ct.), while the mucous coat (see Plate V, muc. ct.) remains quite distinct, and the opening of the bronchus (contrary to the case in pleuro-pneumonia, when the cellular exudation is as extensive as here) is patent and even slightly dilated (condition known as bronchiectasis). This proliferation about the bronchi (known under the name of peribronchitis) may become degenerated finally and thus give rise to the small cavities filled with cheesy detritus noted in the description of the specimen (Plate IV, A).

The commencement of such a degeneration may account for the appearance seen in the middle lobule of the preparation (see also Plate V, tbl.), or it may be due to a secondary tuberculosis.

The whole process can be classified as one of chronic interstitial pneumonia, with peribronchitis and bronchiectasis with the formation of cavities.

STEAMSHIP BRAZILIAN, FROM BOSTON.

The next two specimens examined were both marked S. S. Brazilian, from Boston, and will be described as Brazilian lung No. 1 and No. 2.

Brazilian lung No. 1 consisted of several pieces forming part of the wall of a large abscess. The side of the specimen which lay next to the cavity of the abscess was quite smooth, and the tissue immediately adjoining was firm, dense, and quite homogeneous, so that the outline of the lobules could only be made out with difficulty. This very dense portion extended for about 1-2^{cm}, when the tissue began to assume more the appearance of normal lung; only that between the lobules were firm bands connecting directly with the dense tissue near the edge.

Two preparations were made from this, one from the dense portion and the other from the more healthy looking part.

Upon examining the former (see preparation marked S. S. Brazilian No. 1, near abscess wall, and from which Plate VI has been drawn) it will be seen that the great increase in density is principally due to an increased thickening of the interlobular tissue (see Plate VI, int. tis.), and upon comparing this with the preparation made from the more healthy portion (see preparation marked S. S. Brazilian, recent disease) it will be found that this increase is due, as in the case of the Victoria lung, to a thickening of the walls of the lymph spaces rather than to an organization of a material filling the lymph spaces.

In the thick bands of connective tissue traces of small vessels are seen, showing that the process has been of long duration. The bronchi lying in their midst are still open and to be distinguished by their epithelial lining, but their muscular coat has almost disappeared.

In the recent preparation the alveoli show simply the results of compression, with an increase of round cells in their walls. Near the abscess wall the lobule is quite solidified, but this is due not to an exudation into the alveoli, but to the effects of the compression of the connective tissue and to a thickening of the walls by a round cell infiltration. Scattered through the alveoli lobules, replacing one or two alveoli, in the walls of the smaller bronchi and in the bands of new formed connective tissue are small circular collections of round cells, having a tendency to degeneration with a sharp line between them and the surrounding tissue (see Plate VI, tbl.); these are probably minute points of chronic purulent inflammation, but may belong to the class of tubercles, although only about half the size of those bodies and lacking in giant cells and stroma.

The changes found in this lung are those of chronic induration, which are entirely explained by the proximity to the large suppurating cavity, and have nothing in them indicative of what may have been the cause of it.

Brazilian lung No. 2.—In the second specimen from the Brazilian there were two nodules from different parts of the lung, showing different stages of disease, the one more advanced than the other.

In both of these nodules there were only a few lobules which presented any changes from the normal, and in the more recent specimen it was only in a single lobule that these changes reached a marked degree.

In this the lobule, which was the center of the disease, was quite homogeneous, except in the middle, where a portion of the tissue was separated from the rest by a distinct line of irregularly indented outline. In this portion were numerous small losses of substance, giving to the whole a slightly necrosed look. This central lobule was separated from the adjoining ones by a firm, broad band of tissue, while in the more remote interlobular spaces the walls of the lymph spaces were seen to be thickened, and lying in the spaces thus reduced in diameter by this thickening of the walls, were firm, fibrous-looking masses, which were only slightly adherent to the walls, and could in consequence be withdrawn intact. In contagious pleuro-pneumonia, it will be remembered, the substance filling the interlobular spaces is perfectly continuous from side to side, and cannot thus be withdrawn.

From this specimen three preparations were made, two from the recent nodule and one from the more advanced.

The first of these (see preparation marked S. S. Brazilian No. 2 (A), recent disease) was taken from the recent nodule in the tissue from the neighborhood of the central diseased lobule, and presented to the eye only a thickening of the interlobular tissue with masses in the lymph spaces. Under the microscope it was found that the walls of the lymph spaces were thickened in the same way as in the previous cases, and that the masses lying in the spaces were composed entirely of cells, having none of that peculiar loose, meshed, fibrillated network characteristic of contagious pleuro-pneumonia. About the small bronchus, with its accompanying vessels, a dense cellular infiltration is seen. The muscular coat is quite degenerated, while in one portion of the wall of the bronchus the cells have assumed an indistinctly circular outline about a centrally degenerated point (tubercle?). The changes in the alveoli with their walls are very slight, consisting only in an increase of cells.

The second preparation was made through the central lobule, in which, as described above, was a circumscribed necrosis.

The thickening between the lobules (see preparation marked S. S. Brazilian, No. 2 (B), recent disease) is due, as in the previous cases, to a thickening of the walls of the lymph spaces, with here and there narrowed lymph spaces filled with cells more or less adherent to the walls. In the preparation colored by hæmatoxylon the necrosed portion is brought sharply out by a deep blue line, lying just within its border, and due to the presence of a large number of cells and nuclei. Within this line the alveoli are filled with yellow, finely granular detritus, in which lie scattered nuclei and cells in the process of degeneration. Very few nuclei or cells are seen in the alveolar walls, and the whole looks dead. Within the center of this necrosed portion are seen the blood vessels still pervious, surrounding which is a zone of cell infiltration as shown by the deep color. The bronchus lies between the vessels, but can only be distinguished with difficulty, since the external and middle coats are almost obliterated, the mucous coat destroyed, only one or two projections of the submucous coat.

remaining to mark its character, and the opening of the tube filled with round cells and nuclei.

The walls of the alveoli of the tissue bordering this necrosed portion are very much compressed, and, together with the new cells, which have been inflated, form a sort of wall. The remaining alveoli are comparatively free, although a few are filled with the same yellow finely granular detritus as are those within the necrosed portion.

Within the nodule or more advanced disease was a cavity ½ to 1 centimeter in diameter, surrounded by a thick wall, and the lobule containing it was separated from its neighbors by thick bands of tissue, which could be followed for some distance among the more healthy lobules.

Under the microscope (see preparation marked S. S. Brazilian, No. 2, advanced disease) it appears that the interlobular tissue is composed of the same connective tissue, only rather firmer than marks the preparations already examined, and has apparently been formed in the same way. The wall about the cavity is also composed of a similar fibrous tissue rich in cells, and passes insensibly into the walls of the alveoli which are compressed and slightly thickened, but otherwise comparatively open. Surrounding the bronchi and vessels are an accumulation of cells which have infiltrated the bronchus from without inwards, leaving still a remnant of the epitheleal lining.

The general outline of the cavity is such as to indicate that it had been formed by a necrosis of a circumscribed portion of the lung, as in the more recent specimen. This necrosed portion has been gotten rid of, and the slight wall of separation seen in the recent specimen has been thickened and condensed.

The whole process is one of chronic interstitial pneumonia with peribronchitis and necrosis of the lung tissue.

STEAMSHIP ALEPPO, FROM NEW YORK.

The specimen was a portion of lung about half the size of the palm of the hand, in which was a firm wedge-shaped nodule, the base of which measured 2^{cm} by 2.5^{cm}, and was at right angles to the pleural surface, which was slightly thickened all over the portion of lung. The nodule was quite homogeneous in appearance, with broad bands of tissue separating the lobules. In one of the lobules there were small losses of substance, giving to that part a honeycombed look, and in another lobule there was a small cavity.

The bands of interlobular tissue (see preparations marked S. S. Aleppo from New York, from diseased nodule, and S. S. Aleppo, &c., section of entire nodule) are composed, as in the previous cases, of firm connective tissue quite well vascularized, showing here and there the presence of masses of cells in the narrowed lymph spaces.

The lung tissue is compressed and the alveolar walls are thickly studded with round cells and nuclei. In the honeycombed tissue mentioned above (see preparation marked from diseased nodule) these cells are collected together in little round groups, which were often degenerated in the centers, causing the little losses of substance referred to. The alveoli themselves were filled with exuded masses, detritus, and cells.

The section through the lobule containing the cavity (see preparation marked section of entire nodule) shows that the cavity is surrounded by a thick wall having a slightly reticulated appearance and here and there giving the outline of a circular body. In the remaining parenchyma of the lung are two to three round bodies of a similar size with a rather broad meshed stroma, in which lie round cells (miliary tubercles).

The bronchi and vessels are surrounded by accumulated cells.

Many of the alveoli of the lobules bordering upon the diseased nodule are filled with blood corpuscles, which, however, lie freely within them, and have not uniformly infiltrated all the tissue as is the case in the hemorrhagic infarction of the contagious pleuro-pneumonia.

The whole process can be classified as one of chronic interstitial pneumonia, combined with tuberculosis and the formation of cavities.

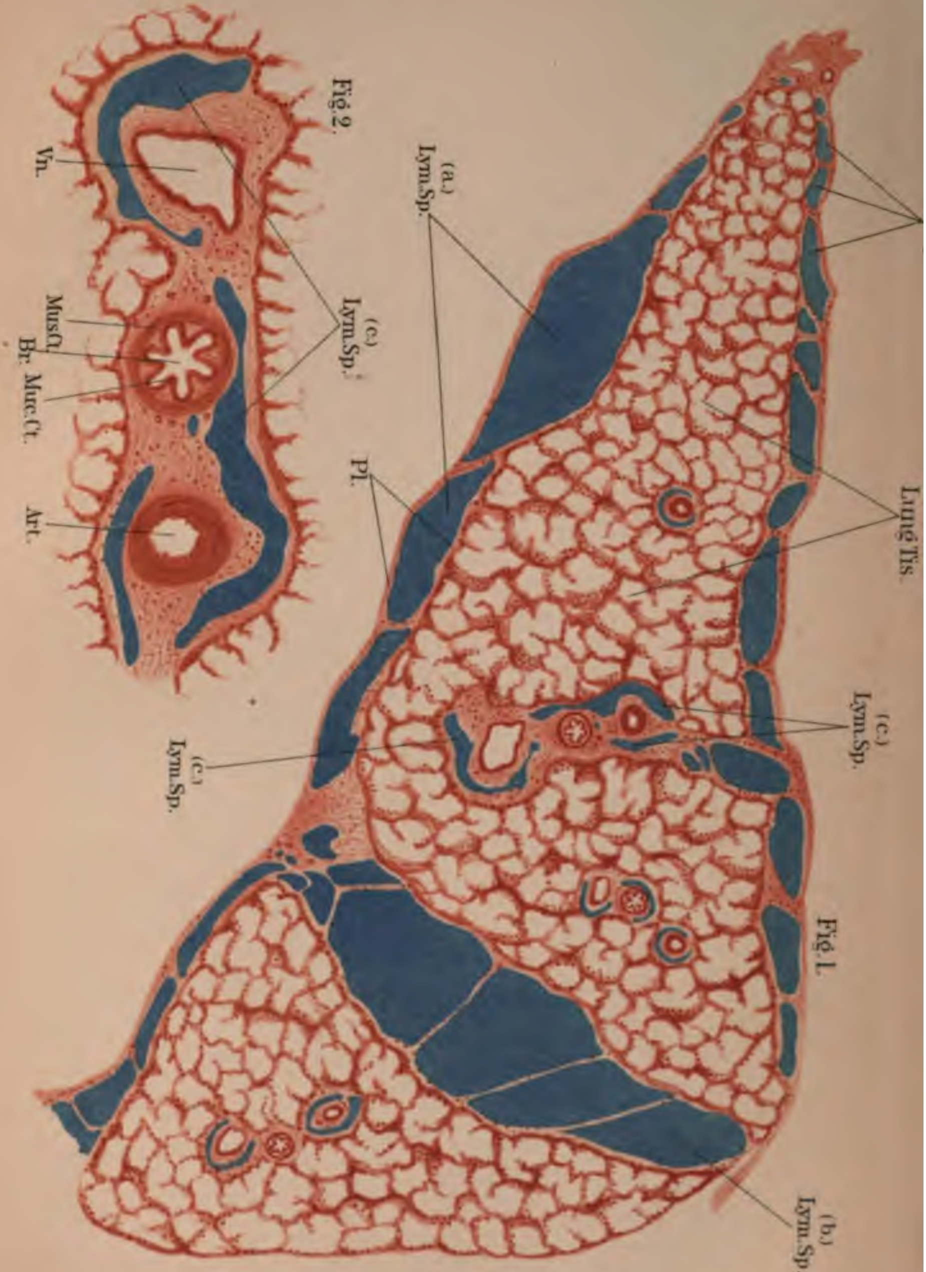
CONCLUSION.

Looking at the cases as a whole, it will be seen that they are the results of inflammations of different parts of the constituents of the lungs, there also being indications in all the specimens that tuberculosis may take part in producing some of the changes.

The antecedence of one process over the other cannot be exactly determined, but judging from the thickness of the interlobular connective tissue, and the fact that it can be distinctly traced among the apparently unaffected lobules, it is probably implicated among the first, and from the fact of the thickness of this tissue as compared with the small amount of lung involved, the processes must be placed among the chronic ones, which require weeks or months rather than days for their accomplishment, and as such are probably not contagious.

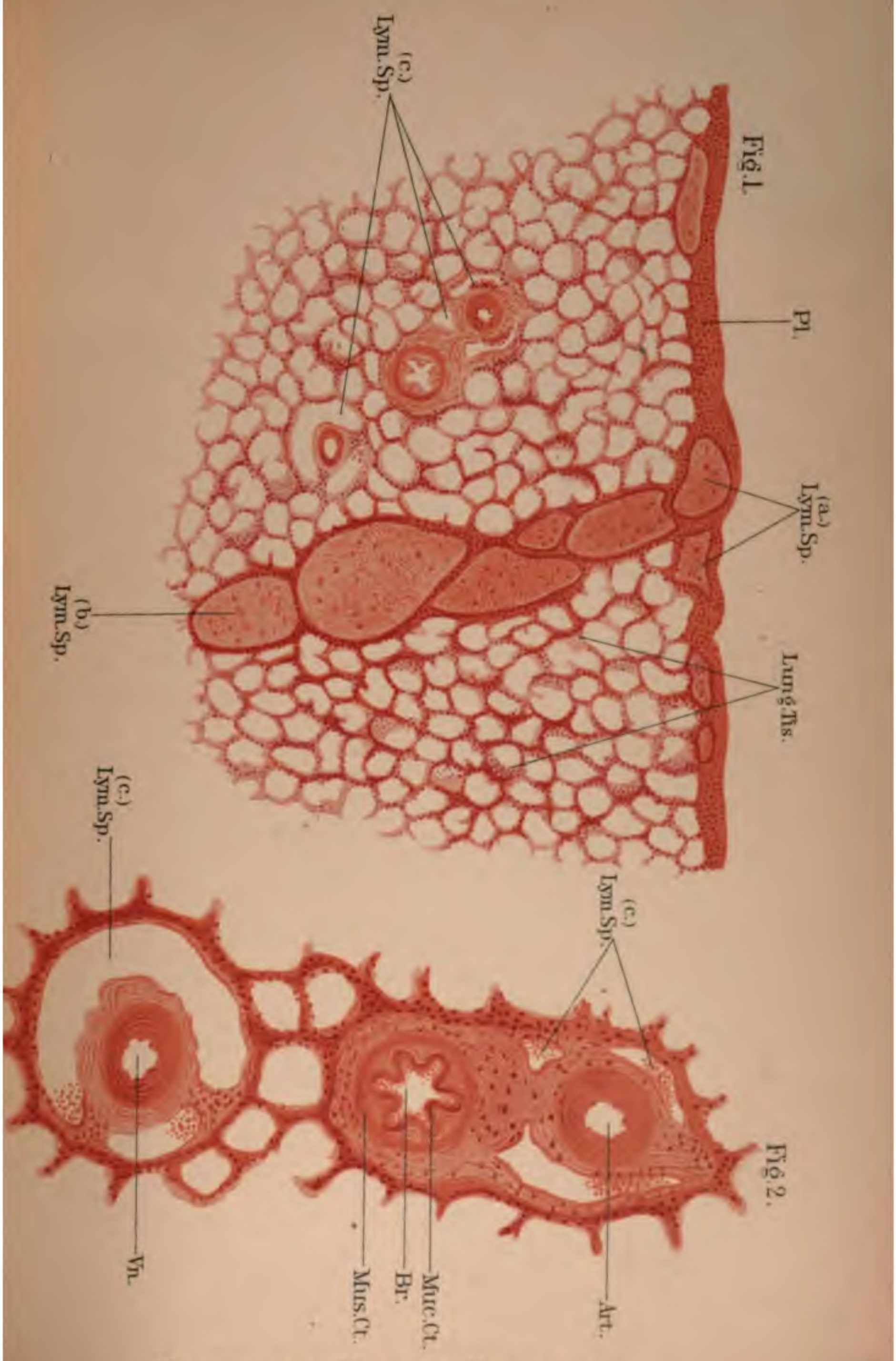
Yours, truly,

W. T. WHITNEY.



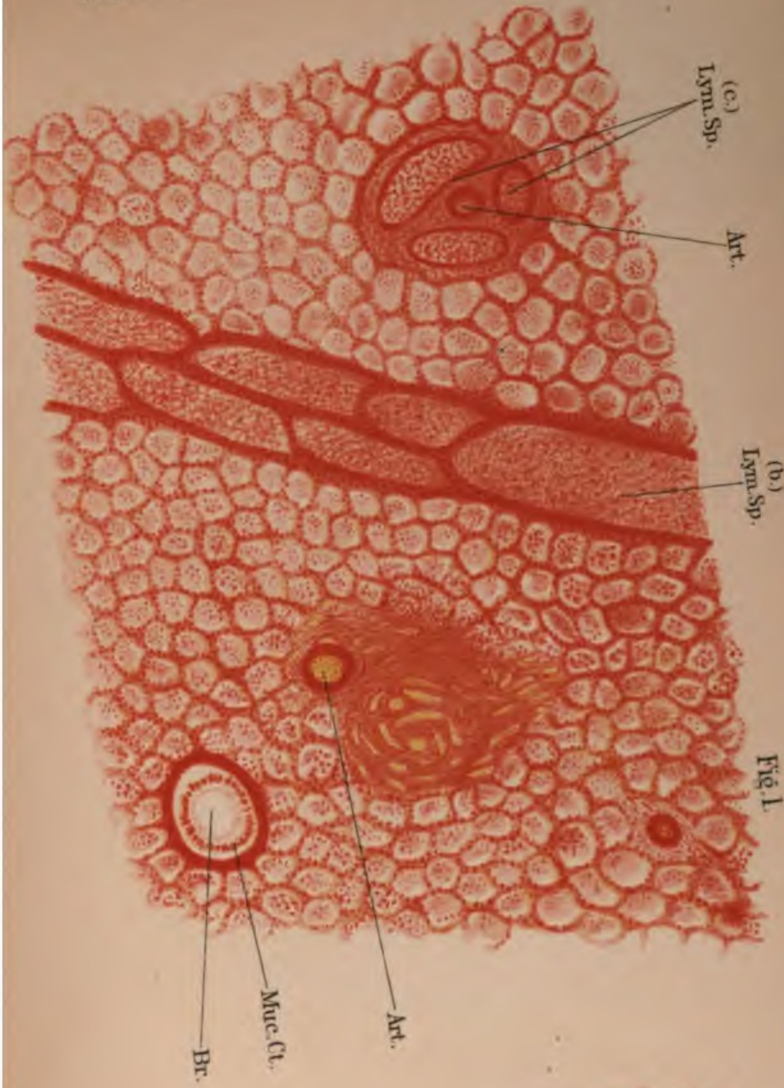
CONTAGIOUS PLEURO-PNEUMONIA

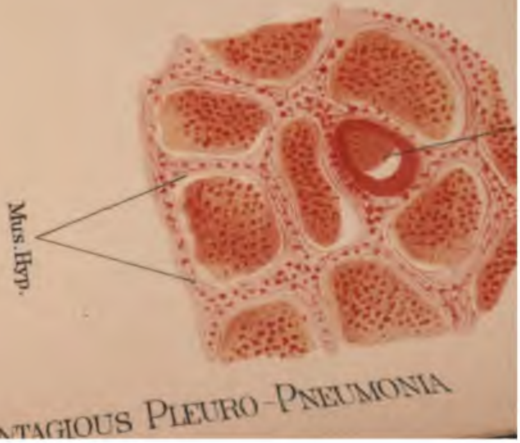
A. Hoen & Co. Lithocaustic Baltimore.



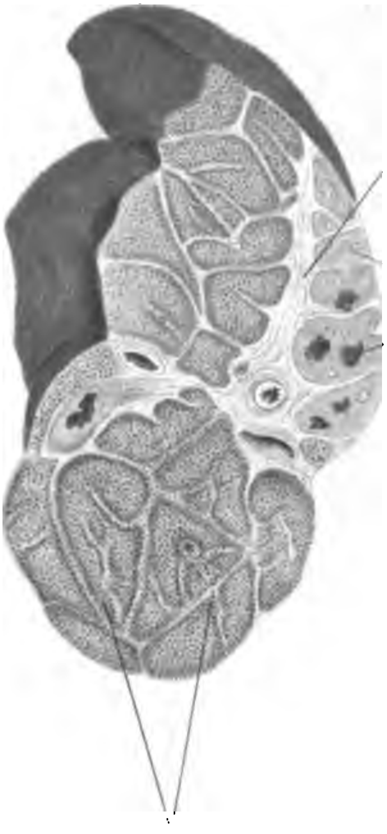
CONTAGIOUS PLEURO-PNEUMONIA

A. Hoen & Co. Lithocaustic. Baltimore.



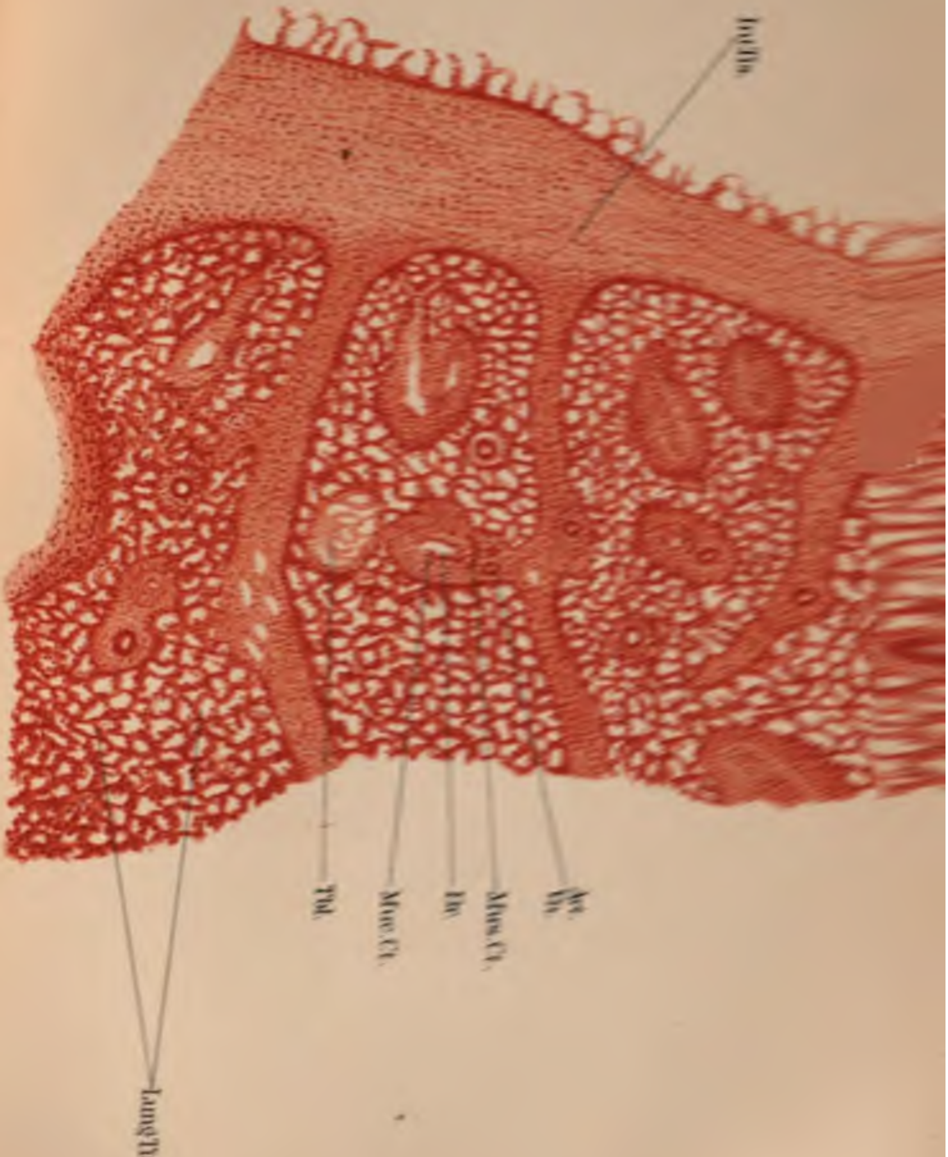


CONTAGIOUS PLEURO-PNEUMONIA



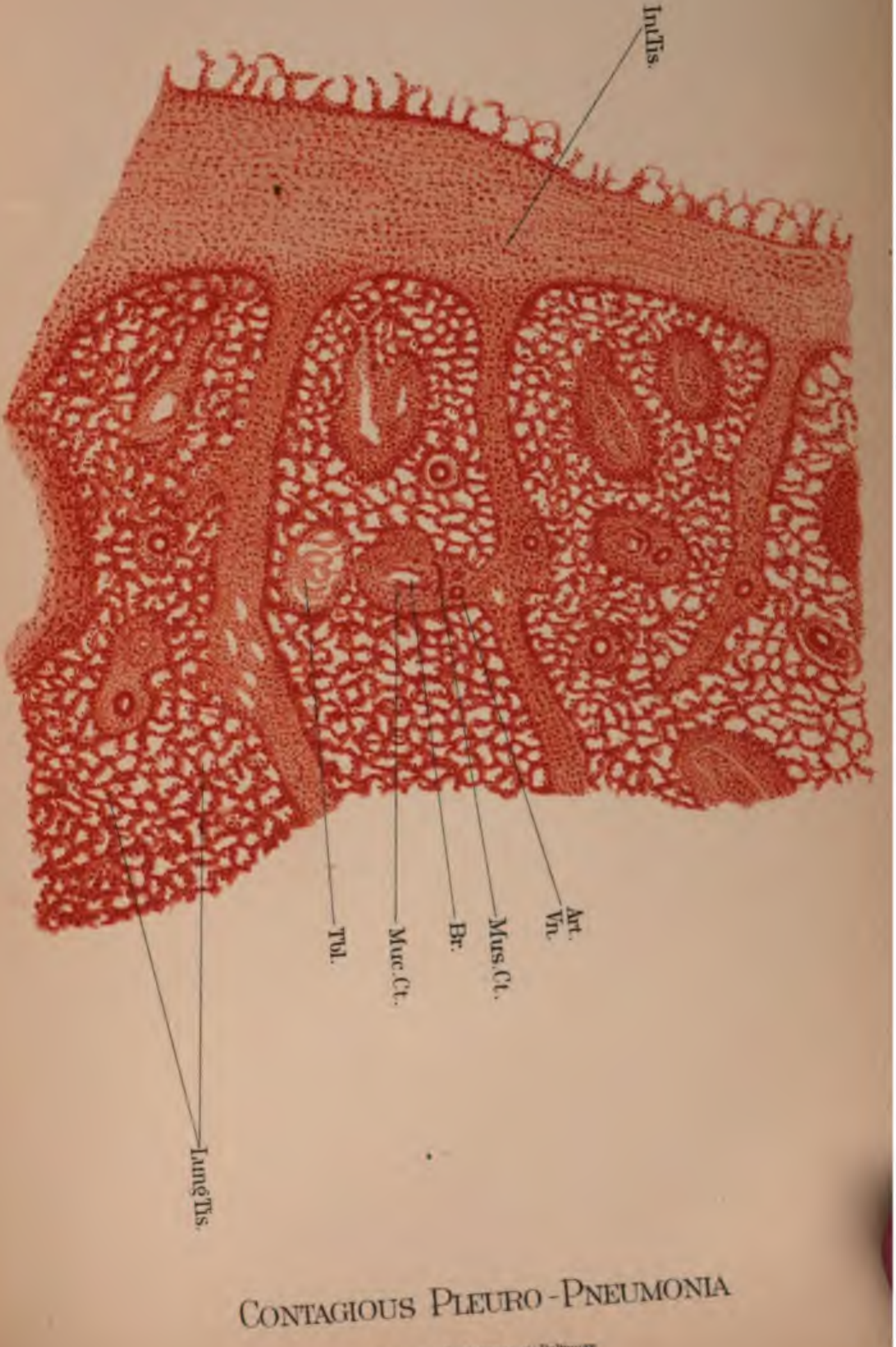
CONTAGIOUS PLEURO-PNEUMONIA

A Hoen & Co Lith. Baltimore



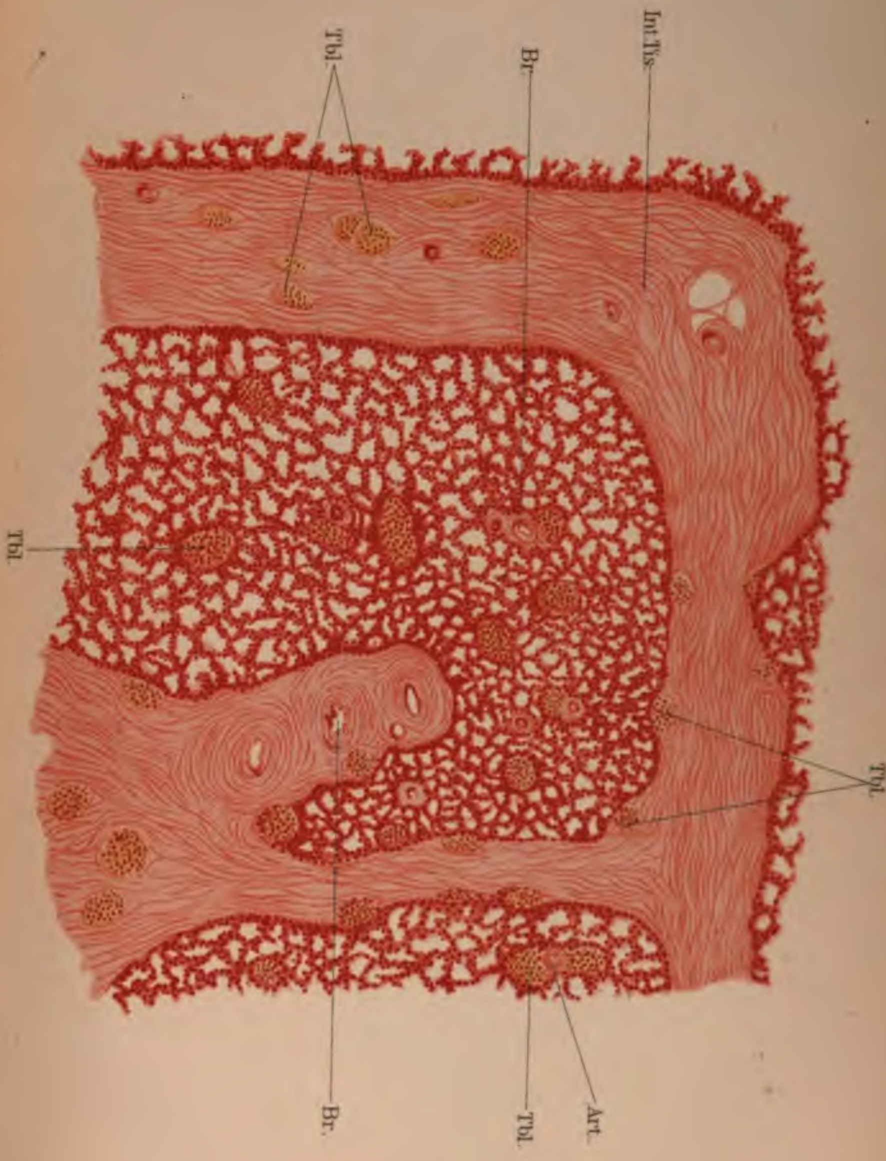
CONTAGIOUS PLEURO-PNEUMONIA.

A. Hoen & Co. Lithocaustic Baltimore



CONTAGIOUS PLEURO-PNEUMONIA

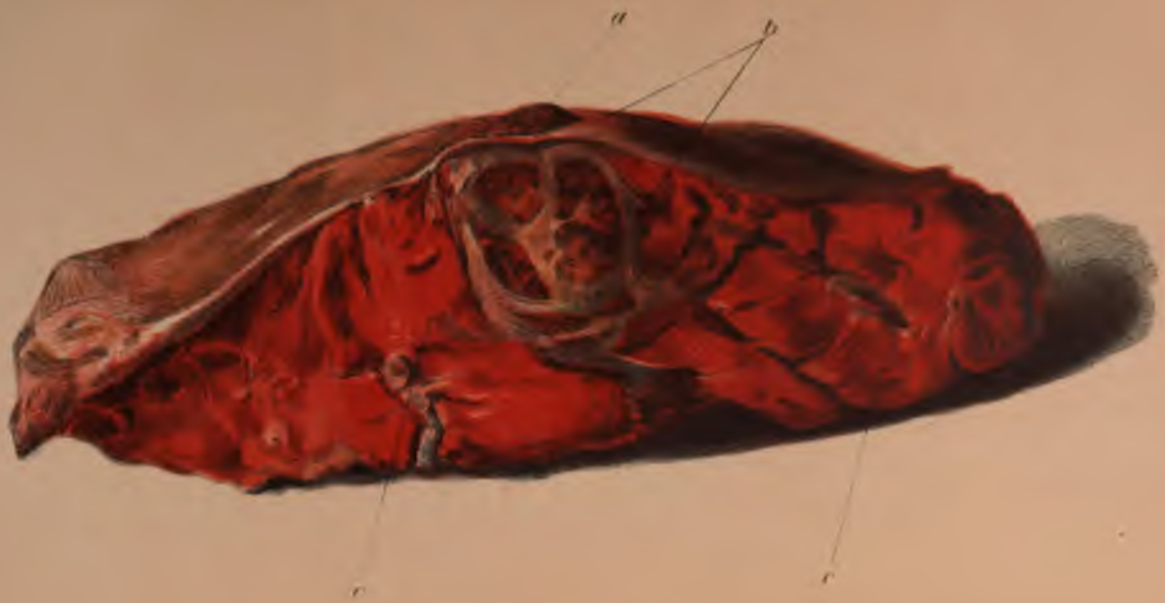
A. Hoen & Co. Lithocaustic Baltimore.



CONTAGIOUS PLEURO-PNEUMONIA

A. Hoen & Co. Lithocaustic Baltimore

CONTAGIOUS PLEURO-PNEUMONIA OF CATTLE.



Portion (natural size) of condemned lung from American Bullock, slaughtered in Liverpool, England.

A. Hoen & Co. Lithocaustic Baltimore

Therefore, if we may place *any* value upon facts as evidenced by the microscope—and who will say that we cannot?—the absolute fact is well shown that not only were the lungs condemned in my presence as being affected with pleuro-pneumonia *contagiosa* not affected with that disease, but that the changes noticed in them, in all but one case, were due to a chronic interstitial pneumonia with peribronchitis, with necrosis and the formation of small cavities at and within the lung tissue proper; and further, there are evidences amounting to a certainty, in one case at least, that the disease known as tuberculosis, probably, plays a more or less prominent part in the etiology of these changes. The other lung (Brazilian No. 1) that cannot be included in this class of cases, was, however, very distinctive, in that the lung contained the large abscess, already described, and the microscope shows the changes in the lung tissues, upon which the condemnation was made, to have been chronic induration of these tissues, caused by the pressure upon them of the large abscess found to exist in their immediate neighborhood; in fact just the condition that under the circumstances we would expect to find. I think that, without pursuing the history of the beasts from which these lungs came, it may be safely stated that they were not affected with contagious pleuro-pneumonia. The next thing, therefore, will be to consider these cases that have been reported as being diseased with contagious pleuro-pneumonia since the time I left Liverpool, and up to the 21st of November last, of which there were seven, as has been already stated. As the lungs, or diseased portions of them, were not obtainable for examination, it will be possible only to show by negative evidence what the probabilities are respecting them. As you will remember they came to Liverpool by various steamships from Boston; to Boston they came from Missouri, Iowa, Illinois, and Ohio, and none of them were at any time in any of the cattle markets except those of Chicago, Buffalo, Albany, and Boston; and the only lines of rail over which any of these passed were the Grand Trunk of Canada, New York Central, Fitchburg, Michigan Central, Vermont Central, Boston and Albany, Lake Shore and Michigan Southern.

It will be shown further on that there cannot be any disease in Chicago or Buffalo, and the same argument will be as true regarding Albany as Buffalo. In the case of Boston I may say that ever since the "stamping out" of pleuro-pneumonia from Massachusetts in 1867 there has always existed, and does to-day, in this State a most efficient board of State cattle commissioners, composed, amongst others, of the same veterinarian (Dr. E. F. Thayer) under whose administration the disease was "stamped out," and that although this board has, during all these years, kept a most lively lookout for any cases of the disease within their State, and although thousands of animals have been examined in Brighton market, alive and dead, by Dr. Thayer, not one single case of pleuro-pneumonia has been discovered within that State within the last 14 years.

Regarding the native States of these cattle, it may be said that in Missouri this department has 104, in Iowa 84, in Illinois 86, in Ohio 83 correspondents, whose particular duty it is to inform themselves as to the nature of any disease that may at any time show itself among the animals within their district, and that these correspondents have not at any time reported the existence of any disease the symptoms of which at all simulated those of contagious pleuro-pneumonia, although every special effort possible has been made to discover it should it exist there. So far as is known, and equally strenuous efforts have been made to discover the facts, pleuro-pneumonia does not exist in any region of country through which the lines of rail over which these animals have been carried passes. This, then, leaves as the only possible source of contamination the cars in which the animals have been conveyed. That the disease may have been contracted in this way is possible, but not at all probable, and as bearing upon this point it may be said that cattle going to Boston for local uses are conveyed in exactly the same way, and oftentimes in the same cars, as the animals going from thence to Great Britain; and that, although I myself have examined many hundreds of these, alive and dead, I have never yet found a single case of contagious pleuro-pneumonia; and this is the fact, as I have before stated, regarding the very extensive examinations made of these same animals by the Massachusetts State board of cattle commissioners.

In considering this question in all its phases, I am naturally led to a review of the circumstances attending the landing and examination of the cargo of animals *ex* steamship Ontario, which arrived at the port of Liverpool on the 26th of January, 1879, consisting of 195 cattle and 2 carcasses; 87 head of cattle had been thrown overboard on the voyage, thus making the original shipment 284. These animals were shipped from Portland, Me., but of their origin Mr. Welsh, Minister of the United States at London, says: "From reliable parties in Liverpool I learn that while a part of the cattle by the Ontario came from Chicago, and a part from Buffalo, at least 45 head of them came from Toronto, and were so mixed with the others that the Canadian and United States cattle could not be distinguished. It is also beyond dispute that those which came from the United States passed for several hundred miles over the Grand Trunk Road through the Dominion of Canada; that all the cattle were exposed to weather of unusual severity; that they remained for a considerable time in Portland without food or water, and that they had undergone an exceptional amount of hardship and bad usage before entering upon a voyage which was made at an inclement season and during excessively rough weather." In a memorandum on the subject, Professor Brown, of the Veterinary Department of the Privy Council, says: "On examining one of the carcasses, the inspector at Liverpool found evidence of pleuro-pneumonia, and forwarded portions of the lung to the Veterinary Department. This specimen was found to represent the characteristic indications of the contagious pleuro-pneumonia of cattle so well known in this country. By direction of the Lord President, I immediately instructed Mr. Duguid, one of the inspectors of this department, to proceed to Liverpool and report as to the condition of the animals which had been detained there. Mr. Duguid remained at Liverpool and superintended the slaughter of the cattle, and in the course of the *post-mortem* examination he detected thirteen cases of pleuro-pneumonia *in various stages*." Now take the statement of Professor Walley, made to me in Edinburgh, in July, 1880, in regard to this matter. He says:

> I was called to Liverpool and there shown animals together in a building which, I was told, came per steamship Ontario from America; a few of them were coughing, I should judge giving the pathognomonic cough of contagious pleuro-pneumonia. *I examined them; they gave no elevation of temperature that amounted to anything as a sign;* they varied a little; some would be a degree higher than others, but nothing remarkable in any. While this examination was going on, *and before we had finished to my entire satisfaction*, a man came to say that we were wanted in the slaughter-house, where we went at once, and found two animals that we were told had been taken haphazard from this cargo of the Ontario, hanging partially dressed, and from these I saw lungs taken that exhibited to me, without any doubt, the well-known lesions of contagious pleuro-pneumonia. I was not at the place for more than an hour.

In answer to questions, he further said:

> The animals were in as good condition as any of the others; that there were several diseased spots in their lungs; that the diseased portions were "marbled," and the pa-

renchyma varied in color from deep red to pink, but it was mostly of a pinkish shade; that there was no attempt towards the formation of a cyst-wall around any of the diseased portions, because the disease had not been of sufficient standing.

I have made these extracts because they seem to me to embrace the entire evidence tending to show that the disease on the Ontario was contagious pleuro-pneumonia; and I think it worth while to put in contrast with them here what may be called the circumstantial evidence tending to show that there may have been some mistake..

The fact seems to be beyond dispute that so far as the animals came from the United States they came from Chicago and Buffalo via. Canadian Grand Trunk Road to Portland. Since 1877 the Department of Agriculture has had, all through the West, regular correspondents, whose duty it is to collect and forward evidence relating to any disease, contagious or otherwise, that may prevail to any extent in the different localities in which they are located. In this way nearly every disease that animal flesh is heir to has received some sort of mention, but in no case has any descripition been received that could in any way be construed into a description of contagious pleuro-pneumonia of cattle. Besides this, the department kept Veterinary Surgeon H. J. Detmers at the Chicago live-stock yards, examining cattle with the single view of ascertaining whether any trace of this disease could be discovered in that great depot for western cattle. This examination, which was made in 1879 and continued for some time, showed that it was unknown there. The market of Buffalo is in the State of New York, and therefore came directly under the examination of Prof. James Law, veterinarian-in-chief to the State of New York, whose particular business, under a special law, was to find and get rid of, so far as any means at his command would allow of its being done, this very disease—pleuro-pneumonia of cattle—and with the splendid system of detecting its existence in any cattle within the State, and with the great facility which he had for tracing any diseased animals that were found to their starting-point, he was never able, in any way, to locate the disease in Buffalo or at any point in the State within 400 miles, or thereabout, of that market. Neither has this department, although every means at its command has been tried, ever been able to find that it had any existence at any time nearer to Buffalo than the points indicated by Professor Law. Now we have in evidence that these animals passed for several hundred miles over the Grand Trunk Road. To do this and get to Portland after leaving Buffalo, they would not again enter the States until they had reached Vermont, where they cross a small portion of the extreme northeasterly corner of the State; thence across the extreme northerly portion of New Hampshire; thence for a short distance across the southerly portion of Maine to Portland; and at no time would they be nearer than Portland to the infected district, the nearest point of which is something over 300 miles away. It may be stated to a certainty that contagious pleuro-pneumonia of cattle does not exist in either Vermont, New Hampshire, or Maine. How, then, could these animals have become infected? So far as the territory through which they traveled on their way to the seaport lies within the United States, it can safely be said that no pleuro-pneumonia exists along, or anywhere near, their line of route. The cars in which they traveled could scarcely have been previously contaminated, for presumably they were those of this great northern trunk line, and would never be sent down into the neighborhood of New York, Philadelphia, or Baltimore for the conveyance of local cattle freight. The only way, then, would seem to be that the disease was contracted on board ship during the voyage. But ships that have carried cattle are, on their return to Liverpool, required by law to be *thoroughly disinfected*, so that unless the Ontario, on her out voyage, brought to this country from England cattle affected with contagious pleuro-pneumonia, she could scarcely convey it to other and hearty beasts on the return trip.

That pleuro-pneumonia did exist among these cattle we have the evidence of, first, Mr. Moore, the inspector, who discovered it; second, that of Professor Duguid, who was sent down from London for the express purpose of inspecting this cargo; third, that of Professor Walley, who came from Edinburgh for the same pourpose, all of them gentlemen who are particularly well qualified to judge of the matter and give a valuable opinion regarding it. But it certainly does seem that Professor Duguid and Mr. Moore were undoubtedly mistaken as to the lungs condemned by them in my presence last July and August. May it not be that pleuro-pneumonia *contagiosa* is, after all, not so distinctive in its appearance as has always been supposed, or rather that changes are produced by certain other diseases, the lesions of which resemble so closely those of contagious pleuro-pneumonia that in the absence of any history of the animal would require a much more careful examination to detect its difference than veterinarians have heretofore supposed to be necessary?

The other gentleman, Professor Walley, says that he should judge that these animals were giving the pathognomonic cough of pleuro-pneumonia, but that he examined them, and even with the thermometer (a most delicate aid in these cases) he could get no indication that amounted to a sign that they were diseased; but still, *before he had finished his examination to his entire satisfaction*, he was called away to the slaughter-house, where he saw lungs removed from two beasts that to him presented "without any doubt the well-known lesions of pleuro-pneumonia." These lungs were marbled, and the parenchyma varied in color from deep red to pink, but it was mostly of a pinkish shade; that the largest diseased spot was as large as the crown of a derby hat; that there was no attempt at the formation of a cyst wall, because the disease had not been of sufficient standing; that the animals were in as good condition as any of the others, and that they had been selected haphazard from among the cargo in question. Is it not remarkable that although so large a portion of lung was affected there was no sign or symptom by which the animal could be selected out from among the others, which, on the testimony of this gentleman, showed no sign that "amounted to anything" of their being diseased, and that the only way of finding its presence was by a critical examination of the lung itself after the animal had been killed? Was ever such a case of acute contagious pleuro-pneumonia with this amount of lung implicated heard of before? I think not; and still this gentleman, who has had great experience with this disease, who knows that in Edinburgh the existence of "pleuro" is generally discovered by an examination made of the live animals in the byre, and not of the dead ones made in the abattoirs, and before he has had sufficient time to finish his examination to his own entire satisfaction, says that without a doubt these animals were affected with contagious pleuro-pneumonia! Now, I submit, are there not in this *evidences* of a huried examination? Has it not obviously been taken for granted that the detection of contagious pleuro-pneumonia, *post-mortem*, was a thing requiring a knowledge only of a most superficial sort? And I ask the authorities in this case if, in view of all the facts, it is not possible, nay, even probable, that a disease of not a sufficiently pronounced character to interfere with the well-doing of these animals may exist that shall give to the naked eye, *upon examination of the lung post-mortem*, the exact appearances of co[illegible]ious pleuro-pneumonia, but which is not that disease, but the result of some chronic process, the nature of which, in the absence of all history of the animal, may require a most careful and minute examination to detect its real differences?

The only gentleman engaged in the affair who seems at that time to have been of my present opinion, and to have realized its importance, is Professor Williams, of Edinburgh, who was called to Liverpool in precisely the same manner as was Professor Walley. This gentleman, who spent more time in the examination, who has had at least as large an experience as have any of the others, said, when he had finished the examination in Liverpool and was asked for his opinion, "I have as yet no opinion to give, and shall have none until I have been able to make a more thorough examination of the lung." For this purpose he took with him to Edinburgh portions of the lung, and he received from Mr. Wellsby, a veterinary surgeon in the employ of Messrs. Warren & Co., the steamship owners, for the next six months, portions of the diseased lungs which were condemned by the inspector at Liverpool, all of which received a most careful examination by himself and Dr. Hamilton, pathologist to the Royal Infirmary, and demonstrator of morbid anatomy in the University of Edinburgh, and after all this he declares that he has "not the slightest hesitation in saying that in no case has he found them to exhibit the characteristic lesions of contagious pleuro-pneumonia." Therefore it seems to me that there is, *at least*, fair reason to doubt whether the disease noticed among this cargo of the Ontario was really contagious pleuro-pneumonia. I have not gone into the discussion of this question in any captious spirit of criticism, neither do I mean for a moment to call into question the professional ability of any of those gentlemen, which I believe to be of the highest quality, and I most thoroughly believe that their decisions were given in accordance with their honest convictions; but if these convictions were arrived at too hastily, and before proper, and, in view of the gravity of the question, sufficiently exhaustive examinations of the facts were made, it is certainly my privilege to comment upon them, and show, if possible, that it was so. And if any statement or argument that I have advanced seems to be of sufficient consequence to really throw a doubt upon the decision of the authorities of Great Britain in this matter, I would most respectfully suggest that in fairness to the great interests of the United States, which are by this decision very severely prejudiced, that the judgment should at least be reconsidered.

My own opinion, arrived at after a most thorough and careful investigation and consideration of the facts, is that the lungs which were condemned by the inspector of the privy council at Liverpool during my stay there in parts of July and August last, as being affected with contagious pleuro-pneumonia, were in reality not affected with that disease. And further, I do not believe that a single case of contagious pleuro-pneumonia has ever existed in the West or has been landed in England from our ports of Boston or Portland, unless, indeed, it may have been communicated to the animals after they were placed on board the ocean steamer, from previous contamination of the vessel, by transportation in it of diseased animals from Great Britain to America, an event which I must say that in the case of pleuro-pneumonia I think to be very unlikely.

Respectfully submitted.

CHARLES P. LYMAN, F. R. C. V. S.

APHTHOUS FEVER, OR FOOT-AND-MOUTH DISEASE.

The technical synonyms for this disease are: *eczema epizoötica*, *aphthis pecorinis*. The English: *epizoötic aphtha*, *aphthous fever*, *vesicular epizoötic*, *murrain*, *epizoötic eczema*.

Reliable evidence is on record of the prevalence of this disease in Europe as far back as the seventeenth century. It was then noticed as frequently prevailing widely in Germany, Italy, and France. It did not make its appearance in Great Britain until 1839, where it quickly spread over the three kingdoms. The most observant writers state that it is an altogether exotic disease in the west of Europe, and always approaches from the east. Dr. Fleming says that it was introduced into Denmark in 1841, and into the United States from Canada in the bodies of cattle sent from England, but he fails to give the year in which it was introduced into this country.

Immediately upon the receipt of the report of the veterinary department of the privy council of Great Britain to the House of Lords in June last, in which the statement was made that a cargo of sheep suffering with this malady had been landed at Liverpool direct from Boston Harbor, a circular was prepared and forwarded to all the correspondents of this department, asking for such information as they could give touching the prevalence or non-existence of the disease in their various localities. In order that correspondents might be able to readily identify the affection, a brief statement of the symptoms was given in this circular letter. Out of some two thousand letters forwarded but few replies were received indicating the possible existence of the disease in this country. However, in view of recent condemnations of American cattle by the veterinary inspector of the privy council of Great Britain, for the alleged existence of foot-and-mouth disease among them, the Commissioner of Agriculture directed Mr. L. McLean, M. R. C. V. S., to visit and examine all suspected localities. After a most thorough and searching examination of animals upon many farms, in a number of feeding and distillery stables, and in the great cattle marts of Chicago, Saint Louis, and Kansas City, he states that he was unable to find a trace of the disease, as will be seen from his report contained in this volume.

As stated in the circular letter above referred to, aphthous fever, or foot-and-mouth-disease, is a contagious eruptive fever, attacking cloven-footed animals. It is also communicable to other warm-blooded animals, including even man. It is not known to have a spontaneous origin, but is believed to be communicated only by contagion. This contagion does not seem to be readily spread by means of the air, a stream of water or common road generally being sufficient to limit it. No poison, however, seems to be more certainly transmitted by contact, direct or through the medium of human beings, tame or wild animals, fodder, litter, manures, clothing, drinking-troughs, &c. Milk is regarded as one of the most frequent sources of contagion to pigs, dogs, and even to infants. The disease is not a very fatal or destructive one, and the most serious damage sustained in the case of milch cows is in the loss of milk; the

FOOT AND MOUTH DISEASE

Report Commissioner of Agriculture for 1880. Plate I

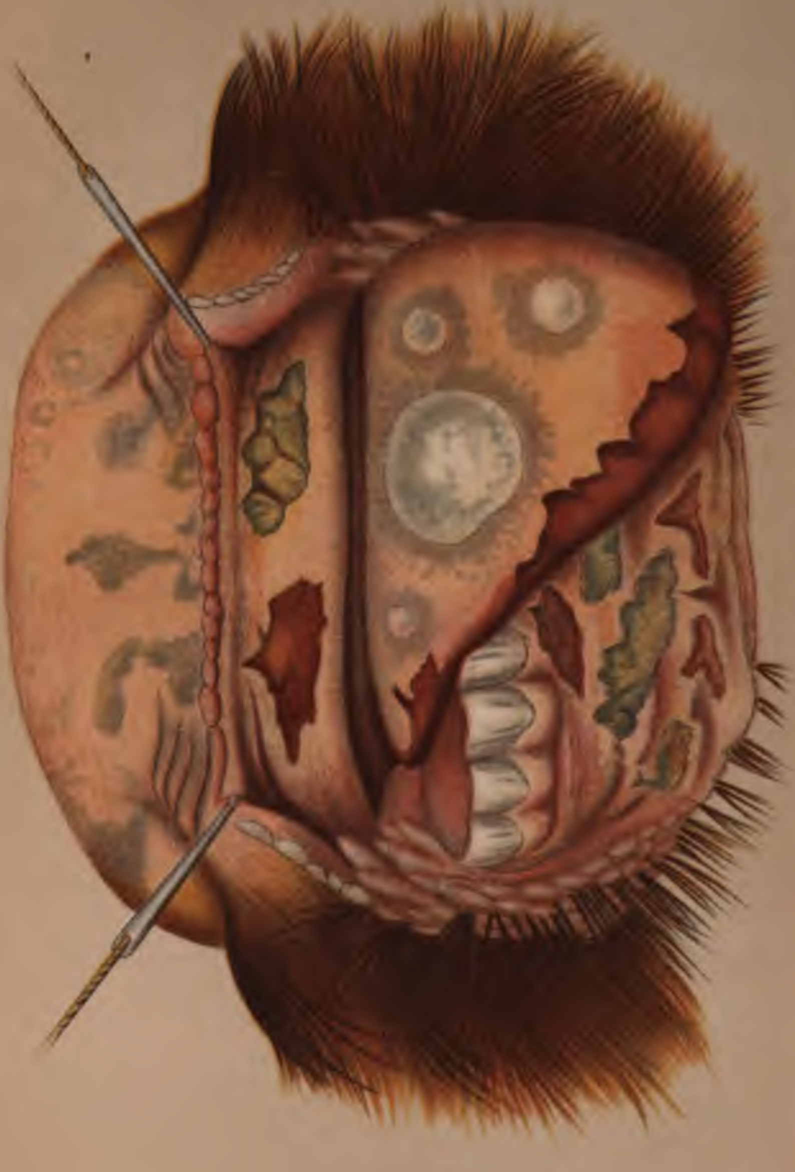
The Mouth in Epizootic Aphtha.

The
pecori
tic, m
Rel
rope
frequ
make
over
altog
from
in 18
sent
duce
Im
ment
June
ferin
Harl
of t
touc
loca
tify
circ
rep
this
cat
for
mis
an
ing
an
Lo
th

fo
fo
in
is
n
or
ev
th
u
n
T
damag

FOOT AND MOUTH DISEASE

Report Commissioner of Agriculture for 1880. Plate I.



The Mouth in Epizoötic Aphtha.

A. Hoen & Co. Lithocaustic, Baltimore.

udders become inflamed, the teats blind, and when the affection extends to the feet a serious lameness intervenes. The animal frequently becomes quite vicious, and is useless for dairy purposes. The average loss of flesh is from five to ten dollars per head among cattle; in dairy cows it is much more. The contagion has a duration of about fifteen days. No permanent ill consequences remain, especially if the animal has been well cared for during the progress of the malady.

The disease is principally confined to cattle, sheep, goats, and hogs, though deer, wild hogs, horses, dogs, poultry, and even human beings have been known to suffer from the contagion. The order of susceptibility to receive the infection may be stated thus: Cattle, sheep, goats, camels, pigs, deer, rabbits, hares, mankind, fowls, dogs, and horses. It affects the skin and mucous membranes, and is charcterized by an eruption of small vesicles, either confluent or isolated, on the lining membrane of the mouth, rarely extending beyond the mouth internally and the interdigital space (seldom the nostrils) of bisulcate animals. The eruption may appear in both of these situations in the same animal, or only in one; in certain outbreaks, or in certain species, one of the regions is more frequently affected than the other. The eruption is observed only in the mouth of a horse suffering from the contagion. In bovine animals the eruption or vesicles frequently appear also on the udder and teats. In sucking animals unmistakable traces of the disease may sometimes be found in the larynx, pharynx, stomach, and intestines. Plate I illustrates the appearances of the vesicles or eruptions, both isolated and confluent, as exhibited on the nose, lips, tongue, gums, &c., of an ox suffering with the malady.

CAUSES.

The causes which originally develop the malady are unknown. It generally appears in an epizootic and rarely in a sporadic form; in certain years it becomes widely extended, invading whole countries, progressing from the east towards the west of Europe. Its extension seems due to its contagious properties alone and the facilities offered for the dissemination of the virus.

As in most other contagious diseases, there are seasons or years in which the malady is much more virulent and malignant than in others. On the continent of Europe it has been observed that these malignant seasons have generally been accompanied or preceded by extensive invasions of anthrax. In Russia it has frequently been observed to be coincident with contagious pleuro-pneumonia, or lung plague of cattle. Veterinarians are of the opinion that individual conditions likewise seem to have some influence in predisposing the organism to its invasion or severity. Among these are enumerated fatigue, bad hygiene, pregnancy and parturition, emigration from one locality to another, lactation, and indifferent, damaged, or sudden change of food.

SYMPTOMS IN CATTLE.

As before stated, this affection is characterized by an eruption of vesicles, or blisters, in the mouth, and on the internal surface of the lips, sometimes in the nostrils, and on parts of the body where the skin is thin and least covered by hair, as on the udder and between the claws. It passes through different phases, and is described under four different periods by Fleming, viz: Fever, eruption, ulceration, and desiccation. The symptoms of the disease are thus described under these four distinct periods:

First period.—Before any perceptible alteration has taken place in the ordinary habits or condition of the animal, the thermometer indicates an increase of temperature, which gradually ascends to 102°, and as high as 104° or even 107° F., in from one to two days, and does not descend to any extent until the end of the eruptive period. The next indication is dullness, inappetence, and slight shiverings. The muffle becomes warm and dry; the eye is tearful, and the mouth hot and inflamed-looking in places, and frequently sore when handled; the membrane being covered with viscid mucus, which flows in stringy masses from the lips. There is grinding of the teeth, and a smacking or clicking noise; the breath has a fetid odor; rumination ceases, and the prehension and often the deglutition of food is painful, the animal preferring to dabble its mouth in cold water. Not unfrequently, when the feet are beginning to inflame, the animal stands uncomfortably, drawing the limbs together, standing uneasy, or jerking them up suddenly under the body, arching the back, and pawing; the movements are reluctantly performed, and the coronets hot and sore. There is also slight constipation, and, if it be a milch cow, the secretion of milk is gradually diminished, and that fluid assumes a yellow tint; in the majority of cases it is nearly or altogether suspended. The udder becomes red and tense when it is involved, and the teats swollen and painful to the touch. This stage usually lasts from twenty-four to forty-eight hours, according to the intensity of the fever.

Second period.—After the time above mentioned, the eruption begins to appear in those parts which are to be its seat, and the fever commences to abate in many cases. When the mouth is chiefly affected, there are seen on its lining membrane, and particularly on the upper lip, gums, and sides of the tongue and palate, white, or yellowish white, blisters, the size of a grain of millet to that of the size of a pea or nut, their form being very irregular. (See Plate I.) Sometimes they are discrete, or scattered over the surface; in other cases they are confluent, collectively forming patches which are at first gray or yellow, and afterwards white; slightly convex; each vesicle is usually circular: the smallest are seen on the muffle. In the mouth they are largest, and most frequently confluent; but there they only exist for a brief period, the friction caused by the movements of the tongue tearing them; the epithelium is detached in flakes of variable dimensions, leaving unhealthy ulcers or denuded spots, or "erosions" of a bright-red tint, which contrasts markedly with the gray hue of the surrounding surface. These shreds are often seen adhering to the border of these sores; and if on the tongue, that organ is kept continually moving to get rid of them, and the animal emits a smacking sound with its lips. Where there is no friction the vesicles do not rupture within one or two days. On the udder the vesicles are somewhat different. The teats are most frequently their seat, and it is not unusual to find the phlyctenæ grouped in a circle around their orifice; when isolated on the surface of the organ they are surrounded by a pale-red circle, and when confluent they are very irregular and variable in number. In the case of a cow the alteration of the milk is very striking.

When the limbs are affected, the heat and rediness of the coronet are most noticeable toward the heel and interdigital space of one or more feet. The coronet swells; the animal is lame, and prefers to maintain a recumbent position. In one or two days the vesicles are developed at the points indicated, most frequently earliest in front of the interdigital space: at first they are small, but they increase in size until they are as large as a bean, or small nut, and extend around the claws, often becoming confluent, the contents appearing as a yellow limpid fluid. The skin of the part assumes a bleached aspect, and is soon covered by a kind of cheesy matter, resulting from the inspissation of this fluid, which emits an ammoniacal odor.

In some cases, the skin around the base of the horns becomes inflamed at the same time as that of the mouth or feet, and the horns are loosened. Occasionally, also, a vesicular eruption manifests itself at the orifice of the vagina, at the perineum and anus, or in the nostrils; and it sometimes happens that the eyes are affected, the conjunctional membrane becoming inflamed and suppurating, and phlyctenæ forming on the cornea. There may also be nasal catarrh and symptoms of gastric derangement.

Third period.—This is the aphthous stage of the disease, and begins when the vesicles have ruptured, and, the epidermis being removed, erosions appear. This does not occur everywhere at the same time, but varies according to the region. In the mouth it soon occurs, owing to the movement of the tongue, and also in the feet by that of the claws. On the udder it is later, seldom occurring before thirty-six or forty-eight hours; or if the disease is benignant the vesicles on this organ may not rupture at all, their contents becoming absorbed, and the pellicle of epidermis covering them sealing off when cicatrization has taken place beneath. When the vesicles do break, there remains a little bright-red sore, which is smooth or granulating, and is soon covered with a fluid pus or yellow exudate of epithelial cells, which, in drying, forms a thin reddish crust that protects the erosion until it heals.

In the mouth and on the lips the vesicles are broken almost as soon as formed, leaving circular or irregular bright-red sores, which bleed readily, their rupture being indicated by dribbling of saliva streaked with blood. It sometimes happens that when the tongue is seized to explore the mouth large patches of epidermis come away in the hand, as if the tongue had been boiled. In some rare cases an exudation of yellow color and cheesy consistency is observed toward the root of the tongue, due to epithelial proliferation.

The fever has greatly subsided, but the thirst is intense, and the animal eagerly drinks water or gruel, though owing to the soreness of the mouth it can eat but little, especially if the food be dry and hard, consequently the loss of condition is rapid.

Fourth period.—This is marked by the desiccation or drying up of the aphthæ, and the formation of new epidermis. The crust falls off, and the new epidermis or epithelium appears as a thin lead-colored pellicle. With the completion of this process all traces of the disease disappear. There is no lameness, the appetite has returned, and the former condition is being restored; while the secretion of milk, which may have been greatly diminished—perhaps to less than one-third—becomes augmented, and regains its normal properties.

SYMPTOMS IN SHEEP AND GOATS.

The fever is not so marked in these animals, though in some instances the temperature may rise as high as in the bovine species. The patient seems weak and dull, lies apart from its companions, and can only be made to rise with difficulty. A smacking sound is made with its lips, which are kept moving as in the act of sucking. The mouth is hot and filled with viscid saliva. The vesicles in the mouth form chiefly on the incisor pad, and the eyes as well as the vaginal membrane may be involved. Fleming states that in these animals the eruption is more frequent on the extremities than on the mouth, but that the formation of vesicles is not very common. More frequently the skin around the claws and in the interdigital space is swollen and more or less red, and from its surface a fluid escapes which, in drying, gives rise to crusts. The inflammation in this region often runs on to suppuration, involving, sometimes, the biflex canal, or producing disunion of the hoofs. If proper precautions are not taken in such cases the disease may assume a very serious form. As in the case of cattle, the loss of condition is more or less marked.

SYMPTOMS IN SWINE.

In swine affected with the disease the eruption in the mouth is rare, that of the feet being most common. The nose and the parts adjoining show the affection when the mouth is involved. The symptoms differ but little from those exhibited by other animals suffering with the disease. The feet are liable to take on a high degree of inflammation. Progression, therefore, causes intense pain, and there appears to be a great tendency to shedding the hoof. If the patient is a sow the udders are implicated as in the case of a cow.

SYMPTOMS IN THE HORSE.

In the horse the early symptoms of aphthous fever are similar to those manifested by the cow when the lesions are in the mouth. "There is fever, the lining membrane of the mouth is hot, red, and covered with a quantity of viscid stringy mucus, while mastication is difficult, and the horse loves to lave its mouth in water." Vesicles, the size of a grain of millet, appear on the inner surface of both lips at the mucous glands. These soon increase to the size of a pea and are filled with a transparent serum. They soon rupture, leaving erosions that are quickly covered with new epithelium. If there is but one eruption of vesicles the disease will pass through all its phases within from seven to ten days; but if there should be a succession of these eruptions the attack may be prolonged two or three weeks. In such cases the animal becomes greatly emaciated.

SYMPTOMS IN BIRDS AND FOWLS.

Birds suffering with the malady show the eruption in different regions. In fowls the vesicles appear more particularly around the nasal openings and on the crest, though they are also seen in the mouth and nostrils. Geese are principally affected on the membrane of the interdigital spaces.

NO IMMUNITY BECAUSE OF PREVIOUS ATTACK.

One attack from aphthous fever affords no protection from a second, third, or even a fourth attack, as animals remain susceptible after being affected several times. Cases are on record of where an animal has suffered as many as five times from the disease, and one cow is reported to have had two attacks in one month. Some veterinarians are of the opinion, however, that animals that have once suffered with the disease are not liable to suffer as severely as those that have never been affected.

COURSE AND TERMINATION.

Under good conditions of hygiene and careful nursing, this fever runs its course, without any very serious constitutional disturbance, within from eight to fifteen days. Convalescence is generally very slow, but is much more so under unfavorable conditions, such as improper care, bad treatment, indifferent hygienic measures, a lack of proper ventilation, &c. Under these conditions the disease may assume a very serious and painful character, by the inflammation in the feet extending to the vascular tissues covered by the hoof, and the formation of dangerous abscesses, of a white color, which can be distinguished under the horn covering them. These abscesses may find an outlet at the coronet; but in cases of neglect this matter may form sinuses and cause the hoof to detach, destroy the ligaments and joints, and ultimately lead to the destruction of the animal. Fleming says that the udder, in case of cows suffering with the disease, may also become the seat of abscesses or induration. In such cases the eruption extends to the intestinal mucous membrane, and to sucking calves, thus drawing their nourishment, this condition is particularly dangerous, as the intestinal canal generally becomes the seat of the eruption. Severe fever, fetid diarrhea, swelling of the head, great prostration, and the death of the young animal soon follows. The appearances in the intestinal canal resemble somewhat the lesions in cattle plague, and this form has been named by European veterinarians the typhoid complication of aphthous fever.

PATHOLOGICAL ANATOMY OF THE DISEASE.

Fleming, in his work on Veterinary Sanitary Science and Police, gives the following pathological appearances of the disease:

> The pathological anatomy of the disease in mild cases is very simple, consisting only in the elevation of the epithelium or epidermis by the limpid fluid that forms the vesicle, and which, by its accumulation and the softening of its envelope, causes the rupture of the latter. The aphtha remaining is very superficial under ordinary circumstances, and in the mouth especially; on the feet, however, the erosion is usually deeper, and in the interdigital region of the sheep frequently becomes a deep ulcer that may cause the disease to be taken for foot-rot. In cattle also, owing to movements constantly taking place, the aphthæ and their accompanying inflammation may destroy the skin, involve the textures beneath the hoofs, lead to loss of these, disease of the ligaments and ultimately of the bones.
>
> Aphthæ and vesicles may also be found on the palate, in the pharynx, and on the mucous membrane of the true stomach and duodenum. In the two last, they more frequently appear as sharply defined ulcers in the middle of the discolored patches. The mucous membrane of the intestines may also be reddened, and marked by hæ-

morrhagic spots; Payer's patches and Brunner's glands partaking of an ulcerous character.

Serous and sanguineous infiltrations have been found among the muscles; but these have been attributed to the fatigue the animals experienced in traveling to the markets. * * * The saliva, when carefully gathered and examined, is perfectly pellucid, contains small stellate crystals, and minute spherical bodies or monads, the latter possessing great activity of movement. In the fluid of the vesicles are large nucleated cells and masses of living germinal matter, besides monads, bacteria, and vibriones. The fluid discharged from the eyes appears to contain similar bodies.

The milk has been found of low specific gravity (1024), though it generally yields a moderate proportion of cream. Large granular cells, or white corpuscles, having the general character of pus globules, were constant and present throughout the whole course of the disease, and even for some time after recovery, though they were most numerous during the height of the malady. Monads and bacteria were also observed, and boiling did not affect their form or movements.

CHARACTER OF THE CONTAGIUM.

According to the opinions of the best German authorities, the contagium of this fever is both "fixed" and "volatile." Some French authorities deny the volatility of the contagium, and contend that it is fixed. This disagreement between eminent authorities leaves this point in doubt, therefore it would be safest to assume that both German and French authorities are correct. Whether volatile or not, the contagium seems to exist in its most concentrated form in the lymph or serum of the vesicles, and in the saliva; but this is not its exclusive vehicle, as other products of secretion, such as the milk of living and the blood of dead animals contain it. In all probability it is present in the volatile as well as in the fixed condition in the excretions. In the first stages of the disease it may not be transmissible in a volatile form, but the evidence would seem to favor such a transmission after the formation of vesicles, and this condition remains until the febrile stage has passed and the vesicles have dried and cicatrised.

VITALITY OF THE VIRUS.

Many of the writers on the subject of aphthous fever give cases showing the vitality of the virus. Rosenkranz says that four weeks after the disappearance of the disease the excrements of infected animals caused an outbreak in a team of oxen employed in carrying it away from the farm and plowing it into the ground. In another instance, given by Haubner, three months after the extinction of the malady in a district, two calves were brought to a manor-house, and ten days thereafter the disease appeared. Fundel has known instances in which the disease has been communicated in infected stables after they had remained vacant for fifteen days. He also states that he has known the virus to be preserved for a long period in forage, although this had not been impregnated by saliva from the disease, but only exposed to the atmosphere of the stable they had inhabited. The outbreak of the fever in Australia in 1872 is said to have been due to the importation of an animal from Britain which exhibited no symptoms of the disease during the voyage. In this case the virus was believed to have been retained in the last truss of hay given to the animal, which sickened therefrom as it entered the harbor at Sidney.

MODES OF INFECTION.

It is a pretty well established fact that the disease is not able to infect at a very considerable distance. Fundel, an authority above quoted, believes that the contagion can be communicated at a distance of 100 meters. Where the disease prevails to any great extent roads are a fruitful source of infection. Animals driven to fairs or to market, if compelled to pass over roads traveled by animals suffering with the malady, are almost certain to become infected. Pasturing animals on commons is another fertile mode of spreading the disease. It is also diffused by means of the stables or lairs in the vicinity of markets. Animals are frequently lodged for one or more nights in such places, where they may meet diseased cattle, or where the infection from these may yet remain. Animals which have come in contact with those afflicted with the fever, even for a very short period, have subsequently infected others, though they themselves remained healthy. Others, apparently quite recovered and free from all symptoms of the disease, have been known to disseminate the contagion. Drinking from the same troughs and feeding from the same ground or out of the racks recently used by sick animals, is almost certain to transmit the contagion. Railway cars and cattle-ships are prolific sources of infection, and disseminate the disease over great distances. Forage impregnated with the saliva, litter on which cattle whose feet were affected have stood, and the clothing of people who have been about the sick animals, will all act as bearers of the contagion. Fleming says that the contagium may find access to the blood by the mouth, air-passages, or any other part where the mucous membrane is thin and vascular, as the generative organs. It may also be absorbed by the skin, as between the claws, as it is readily inoculable. Fowls will contract the disease by frequenting places where the ground or litter is soiled with virulent saliva.

The period of incubation is usually from three to six days after contamination, though it is known to have occurred within twenty-four hours, and in other cases to have been delayed as long as ten or twelve days.

SANITARY MEASURES.

Measures necessary to prevent the invasion or extension of this fever should be similar to those prescribed for other contagious maladies. When the disease appears in a locality, isolation and disinfection should be regarded as the principal measures to be enforced. All infected stables, as well as those immediately adjacent, should be carefully avoided until three weeks after the disease has disappeared. In the mean time all stables, sheds, and transportation vehicles in which infected and diseased animals have been confined should be thoroughly disinfected with carbolic acid or by burning sulphur.

CURATIVE MEASURES.

As a rule, Fleming says, few diseases are more amenable to treatment, and still fewer exemplify the beneficial effects of hygienic measures than this. In the revised edition of Clater's work a number of recipes are given for the amelioration and cure of the disease. In the simple eruptive form as soon as the vesicles are observed a drench composed as follows is recommended:

Take of epsom salts	8 ounces.
Ginger and gentian powdered, of each	2 ounces.

Mix these with one-half pound of treacle and a quart of strong ale and give to a large cow, &c.: three-fourths or one-half may be given to lesser animals and year-olds; one-third for calves up to eight or ten months old, and one-fourth for sheep. Large doses must be avoided, as purgatives cannot be endured. The mouth should be washed twice daily with the following mixture:

Take of alum in fine powder	1 ounce.
Tincture of myrrh	1 fluid ounce.
Water	1 quart.

The healing action will be promoted and accelerated by opening the vesicles in the mouth with a knife or lancet. If matter forms in the neighborhood of the hoofs all detached portions should be carefully removed and the parts dressed daily with a mixture compounded as follows:

Take of tincture of myrrh	2 ounces.
Butter of antimony	1 ounce.

This should be mixed and applied to each sore by means of a feather or piece of tow placed upon a stick. If weakness supervenes, diffusible stimulants, such as ammonia, brandy, &c., must be given, in which a little ginger and gentian should be mixed. When the febrile symptoms prevail, small doses of the sulphate or nitrate of potash are usefully combined with tonics in the following proportions:

Take of sulphate or nitrate of potash	½ ounce.
Sulphate of iron	2 drachms.
Ginger	½ ounce.
Gentian	¼ ounce.

Mix and give daily or twice a day, morning and evening, according to circumstances, in either porter or ale.

Maturation of abscesses should be promoted by the use of hot water, poultices, blisters, &c., and all suppurating surfaces should be kept clean by the use of such dressings as the following:

Take of chloride or zinc	2 drachms.
Tincture of myrrh	1 ounce.
Water	1 pint.

Or the following:

Take of crystallized carbolic acid	½ ounce.
Glycerine	6 ounces.

Dissolve this, and add—

Tincture of myrrh	1 ounce.
Water	1 pint.

As a diet hay tea should be liberally provided as soon as the animal is able to take nourishment. Mashes of barley, malt, oats, with a little linseed to promote the proper action of the bowels are of absolute necessity. Green clover, grass, carrots, swedes, &c., or any other food easy of digestion, are recommended. Overloading the stomach, however, should be carefully avoided.

Cleanliness, good dry beds with proper ventilation of buildings, are necessary requisites. In order to protect the spaces between the digits from irritation, which frequently occurs from the insinuation of straws, dirt, &c., the feet should be bound up after proper dressing, by inserting a rag between the claws and fastening it above the coronets. In cases of affection of the udder, when the abstraction of milk is difficult and painful, the teat siphon should be used for emptying the gland. After the udder is relieved, the following solution may be injected with a glass syringe in order to neutralize the acidity consequent upon the morbid action within:

Take of carbonate of soda or potash	½ drachm.
Water	8 ounces.

Mix and thoroughly dissolve this solution before using; one or two injections for each teat will be found sufficient.

If the udder is much inflamed, common elder ointment rubbed upon the outside is recommended. The extract of belladonna is also regarded as an efficient remedy. The following compound is given:

Take of extract of belladonna	1 ounce.
Hogs lard	6 ounces

Mix by means of a spatula, and anoint the parts daily with as much friction as can be borne by the animal; indurations may be treated afterwards by iodine or mercural ointment.

As the symptoms of this disease are principally of an outward character and can be readily identified, it is not deemed necessary to give the appearances of the lesions as shown in ***post-mortem*** examinations.

INVESTIGATION OF TEXAS CATTLE FEVER.

Report of Dr. H. J. Detmers.

Hon. WILLIAM G. LE DUC,
Commissioner of Agriculture:

SIR: In the following pages I have the honor to lay before you my observations in regard to so-called Texas fever, of which a few cases (seven in all) occurred in September and October among the town cows in Champaign, Champaign county, Illinois. As my opportunities to study the disease by personal observation were limited to only four cases out of the seven, I shall restrict myself to merely reporting the facts as I found them, and shall not offer any conclusions arrived at. Neither do I intend to make an attempt to cover the insufficiency of my own experience by drawing plausible deductions from the experience and observations of others, published in former reports of the Department of Agriculture, in the report of the Cattle Commissioners on Texas Fever in 1868, and in other reports, divers pamphlets, periodicals, &c., accessible to me or in my possession. Such deductions can be made in the study with a library at one's back, and do not require any actual investigation, but are after all mere opinions, and not facts.

On September 3, I learned that two town cows had died of the disease generally known in the West as Texas fever, in that part of the southern portion of the city of Champaign which is situated immediately west of the track and the cattle pens of the Illinois Central Railroad, Chicago branch. Going over there and inquiring further, I found a cow diseased with Texas fever in Patrick Monahan's stable, a few rods from the railroad cattle pens. The diseased animal was a young red cow of common breed, and in very good condition as to flesh, but already thin and gaunt in the flanks. She had shown plain symptoms of disease—had passed red urine—since the morning of September 2.

Symptoms.—The animal was lying down in an unnatural position, the horns resting against the manger. The muzzle dry and moderately hot; horns rather cold, and of changeable temperature; visible mucous membranes pale; breathing laborious; excrements thin and voided in very small quantities; urine, which was passed quite often, and at brief intervals, of a deep red-brown color. The animal showed great indifference to surroundings, but was very restless; she tried several times to get up, and though apparently not lacking muscular strength, did not seem to have sufficient control over her motary apparatus, and several times broke down in the attempt, and then made no effort to correct the unnatural position in which she sank down. Finally she succeeded and got on her legs, soon to break down again, after she had staggered a few steps and passed water, when her want of control over the voluntary muscles became still more apparent.

September 4.—The cow died at 4 o'clock a. m., and the *post-mortem* examination was made at 10 o'clock a. m., or about six hours after death.

Morbid changes—Externally nothing remarkable except that the muscles presented a bloodless appearance similar to those of a slaughtered animal after the skin had been taken off. On cutting the axillary artery and vein and removing the shoulder, so as to give better access to the chest, only a drop or two of pale blood, mostly serum, flowed off. Internally, the lungs healthy, and no morbid changes in any organ of the chest, except a considerable quantity of reddish serum in the pericardium. In the abdominal cavity, the liver considerably enlarged and presenting an abnormally dark color; the spleen over four times its normal size, and on cutting into it, an almost black and grumous-looking substance (blood) oozed out; numerous ecchymoses in the large intestines; kidneys dark and congested, presenting extravasations of blood; bladder full of dark-brown urine, which, although perfectly clear and transparent, proved to contain, when subjected by Professor Weber, of the Illinois Industrial University, and myself to chemical tests, large quantities of albumen.

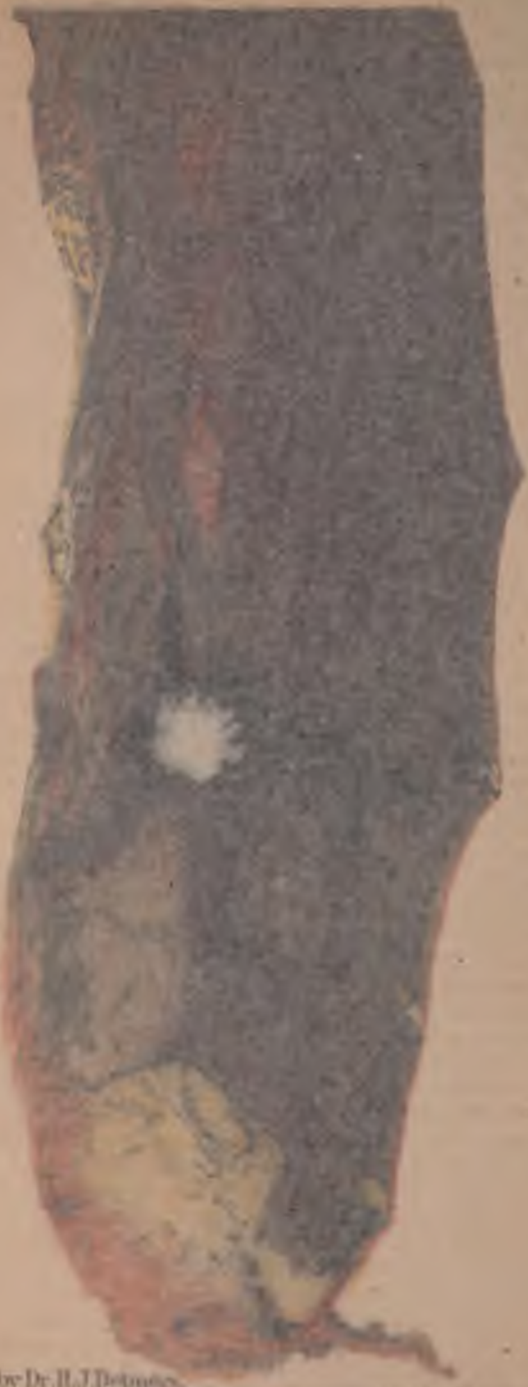
On September 6, late in the evening, I received word from Mr. Monahan that his other cow had passed red-colored urine on Sunday. I went over and found the cow, a large red-and-white milch cow, heavy with calf, in good condition as to flesh, lying in a perfectly natural position in an alley near Monahan's house. The cow, when approached, arose and stretched herself, and when a dog came along she attacked and drove him off. Her muzzle was moist and cold, and no symptoms of disease could be observed; still it must be stated that the night was rather dark, and the light given by the lantern used was dim and flickering. Being unable to go to Monahan's the next day, and not considering the cow very sick, I went there on September 8, at 10 o'clock a. m., and found her in the stable lying down with the hind quarters in an unnatural position, almost doubled up. Visible mucous membranes pale; muzzle dry; horns and extremities cold; temperature in rectum 101° F. The animal appeared to be indifferent to surroundings, but was not as restless as the first cow. Made another visit in the afternoon and found her lying down in a more natural position. She had just been drenched by the owner with some mixture or decoction, a part of which, it seems, had passed down the windpipe into the lungs; at least the animal repeatedly coughed as if something of that kind had happened. The urine, flowing off in my presence, was of a dark-red color, but perfectly clear, uniform in color, and without any perceptible sediment.

September 9.—The cow died at about 4 o'clock a. m., and the *post-mortem* examination was made at 8 o'clock a. m. When the skin was taken off, the flesh was not quite so destitue of blood as that of the first cow, which died September 4, but was also nearly bloodless, and resembled that of a butchered animal. A few drops of blood were collected from the jugularis when the head was cut off.

Internal morbid changes.—The lungs large, not collapsed, somewhat congested, and in the tip of one lobe some incipient hepatization, due undoubtedly to the fact that medicine had been poured down the windpipe into the lungs. The owner admitted that the cow had been drenched several times since she showed the first symptoms of disease, and that nearly every drenching had been followed by a violent fit of coughing. The heart, and everything else in the chest, was found normal. In the abdominal cavity the spleen considerably enlarged (see photograph, plate I), but not near as large as in the other cow. Purplish-black blood oozed from a small cut (presented in photograph), the same or similar in appearance as that of the spleen of the first cow. The liver about three times its natural size, and exceedingly heavy and brittle;

TEXAS CATTLE FEVER.

Report Commissioner of Agriculture for 1880. Plate I.



Investigations by Dr. H. J. Detmers.

Spleen of Animal: affected with Texas Cattle Fever.

ch
ar
ar
cl
te
el
Ir
ar
ar
(b
ne
fu
er
ne
of

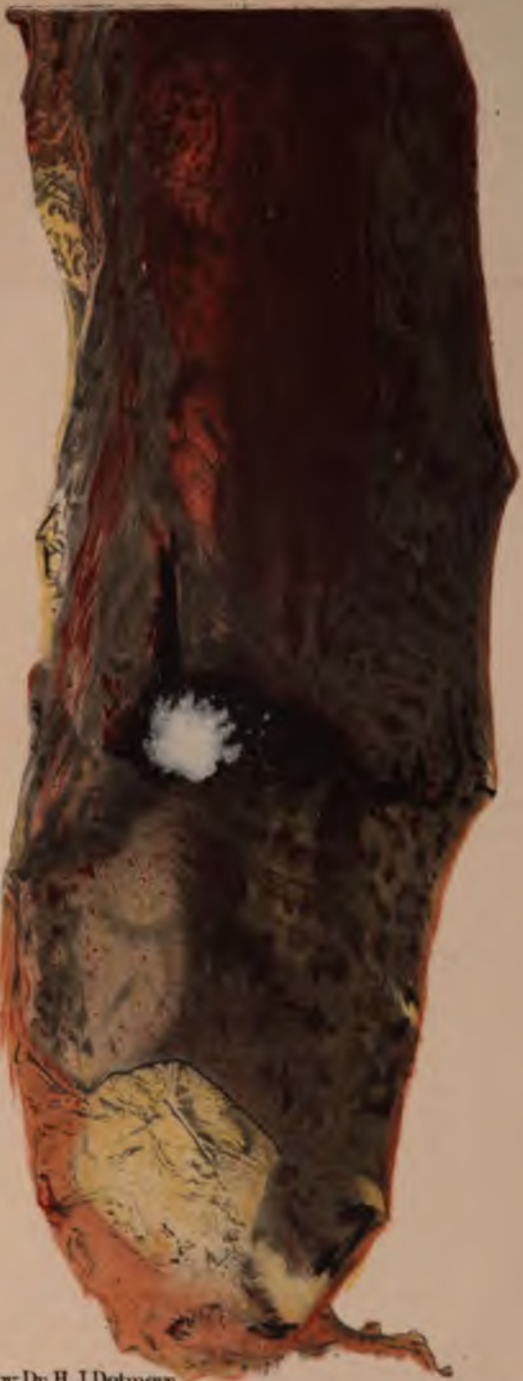
al
o
ir
n
h
n
st
b
a
o
d
V
c
f
a
r
t
I
t
v
c

e
t
c
a
j

similar in appearance to that of the spleen
about three times its natural size, and exceedingly heavy and brittle;

TEXAS CATTLE FEVER.

port Commissioner of Agriculture for 1880. Plate I.



estigations by Dr. H. J. Detmers.

A. Hoen & Co's Lithocaustic Baltimore.

Spleen of Animal: affected with Texas Cattle Fever.

gall bladder very large and full of bile; congestions and erosions in the fourth stomach; kidneys congested, but not otherwise of abnormal appearance, and the urine, of which the bladder contained a large quantity, of a red-brown color, but perfectly clear and transparent. The attack of this cow had been decidedly milder than that of the former; her sickness lasted one day longer before becoming fatal, and death probably would have ensued still later if no medicines had been poured into the lungs.

September 10.—Received word that another cow, belonging to Mrs. Harris, who lives in the same neighborhood with Mr. Monahan, had become affected. I went there at 9 o'clock a. m., and found a fine large cow in the last or paralytic unconscious stage of Texas fever. The head was swelled, the eyes almost closed; the surface of the body rather cold to the touch, and the temperature in the rectum 100°.6 F. The muzzle was dry and the visible mucous membranes very pale. Some dung, which had passed a few minutes before my arrival, was dark-colored and mixed with streaks of blood. The cow was lying down in an awkward and rather unnatural position and unable to rise. Called again at 1 o'clock p. m., and found the animal dead; she had died a few minutes previous.

Post-mortem examination was made about one hour after death, or immediately after the cow had been hauled out of the city limits to a piece of ground belonging to Mrs. Harris.

Morbid changes.—Externally a few bruises on the left side of the body; the meat bloodless, as in Monahan's cows, and presenting an appearance of death caused by bleeding. Internally, all organs in the chest healthy. In the abdominal cavity, the liver enlarged, of a deep mahogany color and gorged with blood; the gall bladder large and full of bile; the spleen about three times its natural size and full of dark-colored blood; the third stomach impacted with dry food and presenting the appearance of a hard and solid body; ecchymoses and congestion in the fourth stomach and large intestines; the kidneys congested and the urine bladder containing a large quantity of brownish-colored but transparent urine, which, like the urine of the two cows of Mr. Monahan, proved to consist largely of albumen.

October 3.—Learned in the morning that another cow, belonging to Mr. Ritschener, who lives next to Mr. Monahan, died of Texas fever. I went there at 9 o'clock a. m., and found a two-year-old heifer, in a first-rate condition as to flesh, lying dead in the corner of an empty lot, to which the carcass had been removed by Mr. Ritschener. The *post-mortem* examination was made immediately. The carcass was very fat, and the flesh, where not already decomposing, presented the clean and bloodless appearance of the meat of a butchered animal.

Internal morbid changes.—None in the chest; the liver much enlarged, gorged with dark-colored blood and very brittle; the spleen also two or three times its normal size, and when cut into a blackish, grumous-looking, and very offensive-smelling fluid (decomposing blood) oozed out; kidneys somewhat enlarged but flabby and lacking that solid appearance of those organs when healthy. The urine bladder was found empty, but a reddish-colored urine dripped off out of the vulva while the skin was being taken off. As the animal had been dead nearly twenty hours, according to Mr. R., the intestines were in a state of decomposition, and therefore not opened. The third stomach, however, was not impacted, and no morbid changes of any consequence were externally visible, or if existing were hid by putrefaction changes. It should be mentioned that some serum was found in the pericardium and in the abdominal cavity.

THE ORIGIN OF THE OUTBREAK.

Seven town cows died, all of which were owned by people living in the immediate neighborhood of the cattle pens of the Illinois Central Railroad. The first cow that died belonged to Mr. Crockett; she was taken sick on August 28, and died, as I have been informed, on August 31. The second, which belonged to Mr. Ritschener, took sick on August 31 and died September 2. Mr. Monahan's red cow, the first one examined, and the third one that died, showed the first symptoms of disease on September 2, and died, as above stated, on September 4, early in the morning. Mr. Monahan's red-and-white cow, the second one that was examined, was the fourth that died, and was sick four days; she died, as stated, early in the morning September 9. Mrs. Harris' cow, which died September 10, was the third one examined and the fifth one that died, after having been sick two days. A cow belonging to a tailor whose name I neglected to take was the sixth, and died in the latter part of September, after having been sick two days. Mr. Ritschener's heifer, which died October 2, was the fourth animal examined, and the seventh and last one that died; she was sick about two days according to the information received. All these animals, together with a very old cow which belongs to Mr. Monahan, and is the dam of the red-and-white cow, the second one examined, had been seen in the cattle pens of the Illinois Central Railroad, which, as a rule, were always open when not occupied till September 7, and contained some old straw, &c., and some manure left there by cattle which had been shipped or unloaded from the cars. It was further ascertained that some time in July or August—I was not able to learn the exact date, for nobody seemed to know or be willing to tell the same—a car loaded with Texan cattle on its way to Chicago, broke down at Champaign, or at any rate became so damaged as to necessitate the unloading of the cattle at the cattle pens; and the owners of the town cows which died, and others living in close proximity to the cattle pens claim that that car load of Texan cattle contained one diseased cow. This is all that could be learned of the source of the outbreak. If compared with what is known about the peculiarities of Texas fever, comment will not be necessary. It may be said, however, that of all the town cows that were seen in the open cattle pens of the Illinois Central Railroad, only one, Monahan's old cow, did not contract the disease, while all others became infected and died.

As nothing definite could be ascertained regarding the exact date at which the Texas cattle were unloaded, and as the cows visited the cattle pens undoubtedly oftener than once, nothing can be said in regard to the length of the period of incubation. Only this much is certain, that Mr. Ritschener's heifer which died October 2, and the cow which belonged to the tailor and died in the latter part of September, did not become infected after September 7, because after that date the cattle pens were kept locked.

EXPERIMENTS.

As only seven cows became diseased and died, and as only three of those seven were examined during life and four after death—the other cases did not come to my knowledge until after the carcasses were buried—and further, as the cold season was close at hand, I had not much chance to make experiments, except by feeding some of my experimental pigs (kept for experimentation with swine plague) with some of the morbid tissues of the dead cattle. I repeatedly gave large pieces of liver, spleen, kidneys, &c., to two of the pigs, but particularly to perimental pig No. 3, a healthy sow pig about ten or eleven months old. She received large pieces of liver, spleen, and kidney on September 5, 9, and 10, and October 3. She greedily devoured them in my presence, but her health was never disturbed, and up to date nothing has happened.

MICROSCOPIC INVESTIGATION.

1. *The blood and blood serum of Monahan's red cow, which died September 4.*

a. The blood of the spleen examined September 4, while yet perfectly fresh, and without any fetid or putrid smell whatever, presented the following: All red blood corpuscles apparently normal; a few white blood corpuscles and numerous micrococci, single and united in very large zoöglœa, but no rod-shaped forms of schizophytæ (bacteria or *bacilli*).

b. The serum of blood which oozed out of the liver on an incision contained no blood corpuscles whatever, notwithstanding its blood-red color, but numerous very large rod-shaped schizophytæ of the genus *Bacillus* (see drawing No. I), and a great many micrococci. The *bacilli* plainly jointed, forming joints while observed under the microscope; on some of those in motion flagella could be seen, provided the motion was not too rapid. The serum contained also epithelium cells, and numerous large zoöglœa (not represented in the drawing). An hour later all the large rod-shaped forms (*bacilli*) in motion, and the flagella seen on many of them. All seem to have a slight reddish tinge even if accurately focused.

A third examination was made on September 5, after the blood of the liver, which had been kept in a so-called homeopathic vial, had become slightly putrid, but no *Bacteria termo* could be found.

The urine of the same cow obtained on September 3, while the animal was yet alive, and examined one hour after it had been passed, contained a few blood corpuscles and numerous large *bacilli*.

2. *Mr. Monahan's red and white cow, which died early on the morning of September* 9.

a. The blood of the spleen, that is, such as oozed out when that organ was cut into (the cut is shown in colored photograph of Plate I), was dark colored, somewhat thick, and of a grumous appearance. Examined microscopically on the same day, it presented an immense number of normal red blood corpuscles, comparatively few white cells, and numerous micrococci. Diluted with distilled water, very large zoöglœa masses, and numerous micrococci, which had been hid from view by the dense mass of blood discs, covering the whole field, became visible.

b. The blood taken from the jugularis, and examined the same day, presented the blood corpuscles, at least most of them, more or less crenated, and contained zoöglœa masses and many micrococci (*cf.* drawing No. III, *a*).

c. The blood of the liver, which oozed out when that organ was cut into pieces, was also examined the same day, and found to contain normal blood cells and numerous micrococci. Drawing No. III, *b*, represents its appearance when examined next day.

3. *The blood and urine of Mrs. Harris' cow.*

a. The blood of the posterior vena cava, caught directly from that vessel in a small so-called homeopathic vial at the time the *post mortem* examination was made, contained—examined under the microscope on the same day—crenated blood corpuscles and numerous micrococci (*cf.* drawing No. IV).

b. The blood of the liver, obtained by cutting into that organ, and examined at the same time (September 10), contained crenated blood corpuscles, immense numbers of micrococci, and zoöglœa masses (*cf.* drawing No. V).

c. Blood of the spleen, such as oozed out of that organ when an incision was made, contained most of the red blood corpuscles normal, some crenated, a great many white cells, and numerous micrococci and zoöglœa masses.

d. The urine taken from the urine bladder, when examined in the evening (September 10), contained a few blood corpuscles and some micrococci, but no zoöglœa.

e. The blood of the liver, examined September 11 at 11 o'clock a. m.—The blood corpuscles the same as on September 10, the micrococci very numerous, and averaging three or four to one blood corpuscle. A few bacteria, apparently *Bacterium termo*, have made their appearance; on an average, one is seen in every third field. Zoöglœa masses, the same as on the evening of September 10, and also a few long, straight, and very thin forms of schizophytæ, resembling or identical with *Bacillus subtilis*, as described and drawn by Cohn, and very much thinner than those found in the blood of the liver of Monahan's cow No. 1. The same, magnified about 925 diameters, appeared to be from one-sixth to one-half an inch in length.

f. The blood of the vena cava, posterior of Mrs. Harris' cow, examined again September 14. (It had been kept in a new and clean vial, closed with a new and clean cork.) It contained numerous large *bacilli*, similar in appearance, but not quite so long as those found in the blood of the liver of Mr. Monahan's cow (see drawing No. I), but only a few micrococci. The blood had become slightly putrid, but did not smell very offensive. The *bacilli* showed less motion than those found in the liver of Monahan's cow, and I am not prepared to decide whether they were the same or not. No blood corpuscles could be found (see drawing No. VI). Examined once more the urine of Monahan's cow No. 2, and found the same full of *Bacteria termo*, single and moving, and in zoöglœa, while the urine of Mrs. Harris' cow, also examined again, contained rod-shaped forms resembling *Bacillus subtilis*, a few *Bacteria termo*, but no zoöglœa.

A final examination of samples of blood of Monahan's cow No. 2 and of Mrs. Harris' cow was made on September 15. The blood of the spleen of the former animal contained immense numbers of *Bacteria termo*, single and moving, and in zoöglœa, while only a few of the large *bacilli*, seen before, and only a few remnants of blood corpuscles could be found. Of the large *bacilli*, not more than an average of two in three fields could be seen; the blood corpuscles, it seems, must have become dissolved; the remnants yet existing presented a granulated appearance. The blood of Mrs. Harris' cow exhibited nearly the same features as at the last examination on the 14th, except that, besides the large *bacilli*, it contained quite a number of lively, trembling *Bacteria termo*, and had become more putrid.

4. *The blood of Mr. Ritschener's heifer.*—On October 3, when making the *post-mortem* examination of this animal, I took some blood from the posterior vena cava, some serum from the pericardium, pieces of liver and of the kidneys, and some of the pulp of the spleen for microscopic examination. All these substances contained large *bacilli* evidently identical with those forms in the blood of the liver of Monahan's cow No. 1, and afforded me a chance to observe by continued and repeated examinations nearly the whole cycle of metamorphoses necessary to the *development* of the *bacilli*—multiplying by fission and propagating

Report Commissioner of Agriculture for 1880.

TEXAS CATTLE FEVER.

Microscopic Investigations by Dr. H. J. Detmers. Plate I.

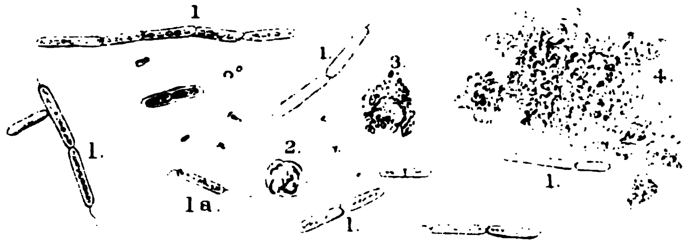
A Hoen & Co Lithocaustic Baltimore

Report Commissioner of Agriculture for 1880.

TEXAS CATTLE FEVER.

Microscopic Investigations by Dr. H. J. Detmers. Plate II.

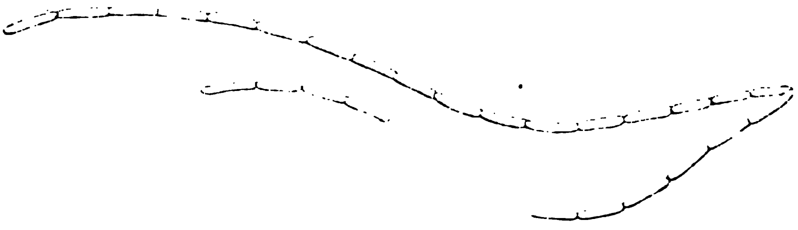
VII.



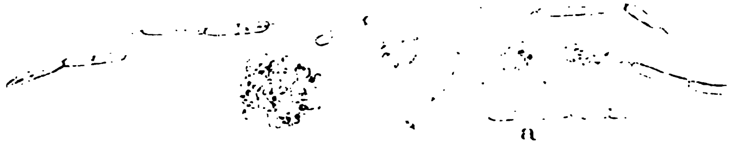
A.- Blood from the vena cava posterior of Mr. Ritschener's cow, examined one hour after the post mortem examination at 10 A.M. 3. 10. 80. × 925. Objective: Tolle's $^{1}/_{10}$ homogeneous immersion. Eyepiece: Book's B.

1. 1. 1. Bacilli, 1a Bacillus with plainly visible flagella and moving.
2. Disintegrating blood corpuscle.
3. Disintegrated blood corpuscle.
4. Detritus.

Average length of bacillus-joints 8,25 μ., varying from 5 μ. to 9,15 μ.



B.- Very long bacillus-chains imbedded in a mass of disintegrated or collapsing blood corpuscles of the blood or pulp of the spleen of Mr. Ritschener's cow. Same time, amplification, objective and eyepiece as above.



C.- Blood from the liver of same cow: bacilli and collapsing blood corpuscles Same time and amplification. a; joint 11 μ long and apparently growing.

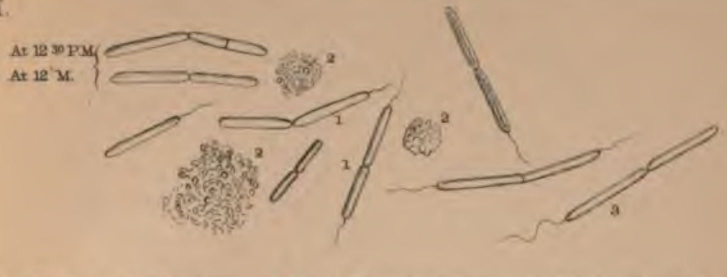
A Hoen & Co. Lithocaustic Baltimore

Report Commissioner of Agriculture for 1880.

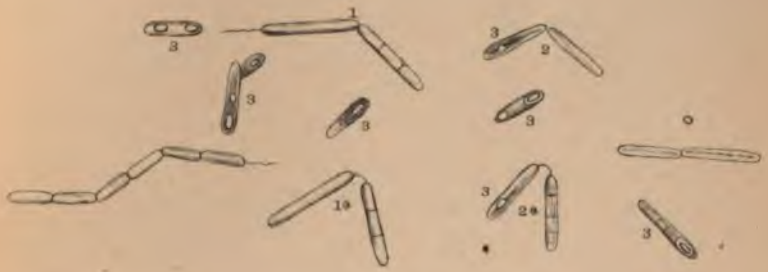
TEXAS CATTLE FEVER.

Microscopic Investigations by Dr. H. J. Detmers. Plate III.

VIII.

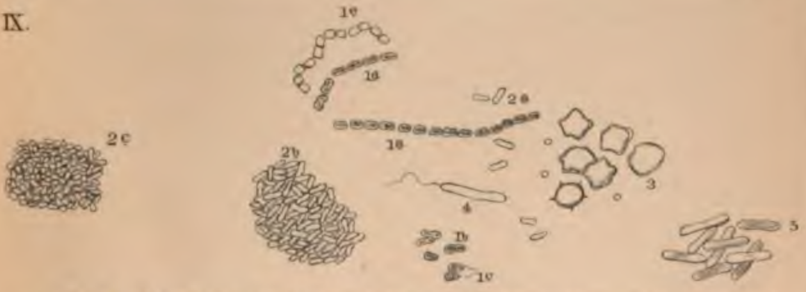


A. - Blood of the liver of Ritschener's cow, at 12 M. same slide as examined at 11, A.M. Same amplification; Eyepiece and Objective. Most of the bacilli (1, 1,) measure each joint 11 μ, and have grown since first examination; 2,2,2, disintegrating blood and detritus. 3, A joint 13 μ long.



B. - Bacilli of the blood of the vena cava posterior of Ritschener's cow on a slide prepared at 10 A.M. as they appeared reexamined at 6 P.M. × 925. Objective: Tolle's 1/18 immersion and Beck's B. 1 and 1^a and 2 and 2^a the same bacilli, 1^a and 2^a 10 minutes later. 3, 3, 3, Helobacteria.

IX.



Blood of healthy beef, obtained in a butcher-shop, as it appeared about 54 hours after death. Examined at 8 P.M. 10, 10, 80. × 925. Objective: Tolle's 1/18 homogeneous immersion; Eyepiece: Beck's B. (No. 2) 1^a Chain of Bacillus germs. 1^b Double Bacillus spores in process of division. 1^c The same 2 minutes later. 1^d Chain of double Bacillus spores in process of division. 1^e The same 2 minutes later. 2^a. Bacterium termo. 2^b Portion of Zoögloea mass of Bacterium termo. 2^c. Portion of very dense Zoögloea mass of Bacterium termo. 3. Blood corpuscles. 4. Bacillus with flagellum. Bacilli at rest.

A. Hoen & Co. Lithocaustic. Baltimore

by lasting spores or helobacteria. All the various changes or forms are faithfully represented in the drawings No. VII, *a*, *b*, and *c*, and No. VIII *a* and *b*, and a detailed description may, therefore, be reserved till the true relation of those *bacilli* to the disease—if any relation is existing and their presence is not accidental—has been determined. I have yet to state that the micrococci found in the blood, &c., of the animals which died of Texas fever, are much larger than those found in swine plague. I have made an attempt to ascertain whether those large *baccilli* are characteristic of Texas fever or whether their presence is accidental. As will be remembered they were found only once—soon after death—in blood from the liver of Mr. Monahan's cow No. 1, and in all other cases, not until the animal from which the blood was obtained had been dead 24 hours. To see, therefore, whether they would also appear in the blood of a healthy bullock, I procured some from a butcher and examined it under a microscope while it was yet fresh or without any perceptible smell, when it had become slightly putrid, and when it was thoroughly putrefied and decomposing. When first examined the animal from which it was obtained had been dead about thirty hours, and nothing abnormal was found except in a few fields one or two *Bacterium termo* were seen. At the second examination twenty-four hours later—the blood was kept in a warm room—it contained immense numbers of *Bacteria termo*, single and in dense zooglœa, and quite a number of *bacilli* identical in appearance to those found in the blood of Mrs. Harris' cow when examined on September 14, and represented in drawing No. VI, but probably different from, or at any rate smaller (shorter and thinner), than those found in the blood of Monahan's cow No. 1 (drawing No. I) and in the blood of Ritschener's heifer (drawings No. VII, *a*, *b*, *c*, and VIII, *a* and *b*). Whether the same, notwithstanding, are all identical or not I am not yet prepared to decide, and if they are it is not impossible in spite of all the precautions taken that the blood of the healthy bullock may have become invaded by bacillus spores in my room, when the vial was opened for a moment to obtain some of its contents for the first examination twenty-four hours before the *bacilli* were found.

Some of the solid tissues morbidly affected, such as the liver, spleen, kidneys, &c., have also been subjected to microscopic examination, but as I expect to get good microphotographs from the slides prepared I will not now give a detailed description.

Respectfully submitted.

H. J. DETMERS.

CHICAGO, ILL., *December* 20, 1880.

ON THE ETIOLOGY OF CHARBON.

Recent French publications contain the results of many important experiments relating to the cause and the manner of the transmission of contagious diseases among domesticated animals. One of the most deadly diseases of cattle and sheep is the affection called *charbon*. Most of the departments of France have suffered severely from the ravages of this disease. There are a number of these departments where the losses annually reach into millions, as, for instance, in the department of Eure-et-Loir. Among the many flocks of sheep raised, there is possibly not one that is not attacked each year. Farmers consider themselves fortunate and give no further attention to the disease when the number of deaths do not exceed 2 or 3 per cent. of the total number of animals in their flocks. This scourge is known to all countries. It is sometimes so disastrous in Russia that it is called the *Siberian pest*. The *Journal d'Agriculture Pratique* of France, of recent date, contains a paper read by M. Pasteur before the Academy of Sciences on the subject of this deadly malady, and the discussions which followed. M. Pasteur said:

> Whence comes this disease? How is it propagated? Is it not possible that an exact knowledge of its etiology may lead to prophylactic measures which may be easily applied and suited for rapidly extinguishing this redoubtable disease? These are the questions I have proposed to solve, and for this purpose I have secured the co-operation of two zealous young observers, M. M. Chamberland and Roux, as enthusiastic as I with regard to the great questions raised by the study of contagious diseases.
>
> It has long been believed that charbon arose spontaneously under the influence of different occasional causes. Nature of soils, water, forage, mode of breeding and fattening have all been invoked to explain its spontaneous existence, but since the labors of Davaine and Delaford in France, of Pollender and de Braéell in Germany, have called attention to the presence of a microscopic parasite in the blood of animals dead from this disease; since rigorous research has victoriously combatted the doctrine of the spontaneous generation of microscopic beings; and, finally, since the effects of the principal fermentations have been ascribed to microbes, we have gradually become accustomed to the idea that animals attacked by charbon may take the germs of the parasite from the external world, without there being a spontaneous birth, properly so-called, of this affection. This opinion was still further confirmed when Dr. Koch, of Breslau, in 1876, demonstrated that bacteridium, under the form of vibriones or bacillus, may be resolved into germ corpuscles or spores.
>
> Two years ago I had the honor to submit to the minister of agriculture and to the president of the council general of Eure-et-Loir a plan for researches upon the etiology of charbon, which they promptly accepted. I also had the good fortune to find in M. Manoury, mayor of the little village of Saint Germain, a few leagues from Chartres, an intelligent agriculturist, who kindly tendered me the use of a small flock of sheep upon his farm, under the conditions of folding usually followed in Beance. Besides, the director of agriculture obligingly placed at our disposition two apprenticed shepherds from the Rambouillet school to superintend and feed the animals.
>
> The experiments commenced in the first days of August, 1878. They at first consisted of feeding certain lots of sheep with luzerne, which was sprinkled with artificial cultures of charbonnosis bacteridia, charged with the parasite and its germs. Without entering into details, that will find place elsewhere, I shall sum up in the following points our primary results:
>
> Notwithstanding the immense number of spores of bacteridia ingested by all the sheep of the same lot, many of them escaped death, often after having visibly diseased, others in smaller numbers died with all the syptoms of *spontaneous* charbon, and after a varying time of incubation of the disease which lasted from eight to ten days; yet in the latter days of life the disease assumes those almost startling characters fre-

quently described by observers, and which have led to belief in an incubation of short duration.[*]

The mortality is increased by mixing with the tainted food, sharp objects, especially the pointed extremities of the dried leaves of thistle, and the barbs of barley heads cut into fragments about half an inch long.

It is very important to know whether the autopsy of animals dead under these conditions exhibit lesions similar to those observed in animals spontaneously dead in stables, or in flocks folded in open air. The lesions in the two cases are identical, and confirm the conclusion that the beginning of the disease is in the mouth, or the back part of the throat. Our first determinations of this kind were made on August 8th by autopsies executed under our direction by M. Boutet *fils*, and M. Vinsot, a young veterinary student from the school at Alfort, who assisted us with great zeal throughout the entire duration of the experiments made at Saint Germain.[†]

Thenceforth the idea which prevailed in our researches, to determine whether animals spontaneously dead of charbon in the department of Eure-et-Loir are infected by spores distributed upon their food, took strong hold in our minds.

There still remains the possible origin of the germs of bacteridia. If we reject all ideas of the spontaneous generation of the parasite, it is natural first of all to give attention to animals buried in earth.

The following is what happens every time an animal dies spontaneously of charbon; if an establishment (*d'equarissage*) for skinning and cutting up horses is near, the cadaver is carried to it. If it is too far removed, or the animal has little value, as is the case with sheep, a ditch 1½ to 3 feet deep is made on the place in the field where the animal died, or in a field near the outbuildings, if it died in the stables, and it is buried by covering with earth. What happens in the ditch, and may not an opportunity occur here for the dissemination of the germs of the disease? Many persons reply, no; since it follows from the exact experiments of Dr. Davaine that the charbonnous animal after putrefaction can no longer communicate charbon. Quite recently also numerous experiments have been instituted by one of the learned professors of the Alfort school, who is a great partisan of the spontaneity of all diseases. He concluded, "That water charged with charbonnous blood, *débris de rate*, earths obtained by stratifying sand, soil, and manure, with cadavers brought from Chartres, never, (by inoculation) provoked the slightest manifestation of a charbonnous nature" (Cohn, *Bulletin de l'Académie de médecine*, 1879). But account must here be taken of the difficulties of the research, difficulties which M. Cohn entirely failed to recognize.

To separate from the soil of a field, and show the evidence of corpuscles of one and two thousandths of a millimeter in diameter, capable of giving charbon to animals, is a difficult matter. By suitable washings, and profiting by the power of these corpuscle germs to infect guinea-pigs and rabbits, it would be an easy thing if these charbonnous parasites were the only ones in the soil; but the latter contains an infinite multitude of microscopic germs of various species, which, when cultivated in the living animal, or in races, are injurious to each other.[‡]

---

[*] Communication of the disease by means of food tainted with charbonnous spores, is more difficult in *cobayes* than in sheep. In numerous experiments we have failed to find an example. In this case the spores were found in the excrements. They are also found intact in the excrements of sheep.

[†] An extraordinary circumstance which occurred in our experiments is worthy of mention: Eight of the experimental sheep were inoculated directly by puncture with the aid of cultures of bacteridia, and some of them even with charbonnous blood of a sheep, dead some hours previous, and which was filled with bacteridia. All the sheep were sick, with decided elevation of temperature; one only, which had been punctured under the tongue, died. One of the sheep which recovered, had received by the thigh, with a Pravaz syringe, not less than ten drops of charbonnous blood. These facts, pointed out to M. Toussaint, who was at the same time occupied at Chartres with the study of charbon, and who sometimes assisted at our experiments in the field of Saint Germain, seemed to him so surprising that he could not believe them until he had himself made one of the inoculations. The sheep, like all the others, survived. Chickens which have been fed upon food tainted with the microbes of chicken cholera, when they do not die may be vaccinated. It is therefore reasonable to ask if sheep may not become vaccinated for the charbonnous affection, by previously and gradually subjecting them to meals infected with spores of the parasite.

[‡] I am strongly led to believe that it is in the infinite quantity of these microscopic germs that must be sought the true solution of nitrification which MM. Schloesing and Muntz have so well shown to depend upon a sort of fermentation. One day (it was, if I remember correctly, in the month of July, 1878, when I was very much preoccupied with all the microscopic germs of arable soils) I received a visit from these learned observers. They brought me "*billes*" from their nitrifying tubes, affirming that from excellent proofs they had given, something living, existing upon the surface of these "*billes*," must be the nitrifying agent; but, they added, we have carefully exam-

I have called the attention of the Academy to these struggles for existence between microscropic beings during the past twenty years; also that to extract from the soil the charbonnous bacteridia that it may contain in the state of germ recourse must be had to special methods, often very delicate in their application; action of air or vacuum changes in the cultural media, influence of more or less elevated temperatures, variable with the nature of the different germs, are some of the artifices which must be employed to prevent one germ from masking the presence of another. All rude methods of research are fatally condemned to impotency, and negative results prove nothing, except that in the experimental arrangement employed bacteridia did not appear. The principal argument invoked by the learned professor at Alfort with the support of the negative results of his numerous inoculations is, that charbon disappears in the cadaver of a charbonnous animal as soon as it putrefies. This assertion is correct, and it was well known to *equarrisseurs** even before Dr. Davaine gave the confirmation of this fact. I have often heard *equarrisseurs*, whom I have seen handling charbonnous animals, and whom I warned of the risk they ran, assert that the danger had disappeared when the animals were *advanced*, and that there was no need for fear, except when they were still warm.

Still, though taken literally, this assertion may be incorrect, it betrays the existence of the fact in question. In a previous work M. Joubert and I gave the true explanation of this phenomenon. As long as the bacteridium in the filiform condition is deprived of air, maintained in vacuum or in carbonic-acid gas for instance, it tends to become resolved into compact, dead, and inoffensive granulations. Putrefaction places it precisely in condition for decomposition of its tissues. Germ corpuscles, or spores, do not experience this effect, and are preserved, as Dr. Koch was the first to show. Be that as it may, and since the animal at its death contains the parasite only in its filiform condition, it is certain that putrefaction destroys it throughout the entire mass.

If we stop at this opinion, and apply it absolutely to facts of this nature, we have but a partial comprehension of the truth.

Let us imagine the burial of the cadaver of a cow, horse, or sheep, dead from charbon. Then even though the animals have not been cut up, is it possible for the blood not to be distributed outside the body to a greater or less extent? Is it not a common characteristic of this disease for the blood at the time of death to issue from the nostrils and mouth, and the urine to be frequently bloody? Consequently, and in all cases, as it were, the earth about the cadaver is tainted with the blood. Besides, several days must elapse before the bacteridia can be resolved into inoffensive granulations under the protection of gas free from oxygen set free by putrefaction, and during this time the excessive bloating of the cadaver causes the internal liquids to flow out by all the natural openings when there is no rent in the skin and tissues caused by the enlargement. The blood and other matters thus mixed with the surrounding aerated earth are no longer in the condition of putrefaction, but rather in that of a medium of culture, suited to the formation of germs of bacteridia.

Let us at once hasten to demand from experiment a confirmation of these preconceived views. We have added charbonnous blood to soil sprinkled with yeast water or urine at summer temperatures, and at temperatures which the fermentation of cadavers should maintain about them, as in a manure. In less than twenty-four hours there was a multiplication and resolution into germ corpuscles of the bacteridia transmitted by the blood. These germ corpuscles were afterwards found in their latent living state ready for germination, and suited to the communication of charbon, not only after months, but even after years of sojourn in the earth.

But these are only after laboratory experiments. It is now necessary to determine what happens in open field with all the alternations of dryness, moisture, and culture. In the month of August, 1878, we therefore buried in a garden on the farm of M. Manoury, after having made an autopsy, a sheep spontaneously dead from charbon.

Ten months, and then fourteen months later, the earth of the grave was collected, and it was easy to determine in it the presence of germ corpuscles of bacteridia, and by inoculation to communicate the charbonnous disease to guinea pigs, and cause their death. Further, and this circumstance is worthy of the greatest attention, this same search was successfully made in the earth of the surface of the grave, although

---

ined and observed, and we find no microscopic beings. See for yourself. I examined these billes, and said to them: "You are right; there are no microscopic beings, but it swarms with their germs which your waters have deposited, and these I believe to be your nitrifying agent." In other words, I am led to deny the existence of a special ferment, a being in course of development—they would rather denitrify under this condition—but a physical effect of absorption and transport of oxygen to the elements of ammonia by the innumerable germs in the earth, effect of transport similar to that effected under the influence of mycoderma aceti in alcoholic liquids in course of acetification.

*Persons who skin and cut up dead horses.

in the interval this earth had not been stirred. Finally, experiments were made upon the earth of graves in the Jura, in which two cows, dead from charbon in the month of June, 1878, had been buried 2 meters (6.8) deep. Two years later, that is, recently, we collected earth from the surface, and extracted deposits which readily gave charbon. In three trials, during this interval of two years, the same earths from the surface of the graves gave charbon. Finally we have recognized that the germs at the surface of earth covering buried animals are found after all the operations of culture and mowing. These latter experiments we made upon earth of our fields on the farm of M. Maunoury. At points removed from the graves, on the contrary, the soil failed to yield charbon.

I would not be surprised if at this moment doubts of the correctness of the preceding facts arose in the minds of the Academy. Will earth, which is such a powerful filter, allow the germs of microscopic beings to rise to the surface?

These doubts may even find support in the results of the experiments that have heretofore been published by M. Joubert and myself. We announced that spring-waters which proceed from even very slight depths in the earth are deprived of all germs to such an extent that they can no longer fertilize liquids which are most susceptible to alteration. Such waters are, however, underneath soils incessantly traversed by rain waters, sometimes for centuries, the effect of which should constantly be to cause the finest particles of superposed earth to descend to these springs. But notwithstanding the proper conditions for becoming tainted, they indefinitely remain perfectly safe, which is a manifest proof that earth of a certain thickness arrests all solid particles of the most attenuated kind. What a difference in these conditions and the results of the experiments I have just related, since it is a matter of microscopic germs, which, starting from considerable depths, rise to the surface, that is in a direction opposite to the flow of rain-waters, and to great heights. There is an enigma here.

The Academy will be thoroughly surprised by the explanation. It may even be startled by the thought that the theory of germs, scarcely the result of experimental research, should reserve to science and its applications such unexpected revelations. Earth worms are the bearers of the germs, and they bring this terrible parasite to the surface of the ground from the depths to which it has been buried. It is in the little cylinders of earth, of fine earthy particles, that the worms excrete and deposit at the surface of the ground after morning dews, or after rains, that are to be found, besides a crowd of other germs, the germs of charbon. The experiment is easily made; cause the worms to live in earth into which spores of bacteridia have been mixed; open their bodies a few days later, and extract with all suitable precaution the earthy cylinders filling their intestinal canals, and in these the charbonnous spores will be found in large numbers. There is every evidence that if the mellow earth of the surface of the graves of charbonnous animals contain germs of charbon, and often in large quantity, these germs come from the disintegration of the little excrementitious cylinders of the worms by rain. The dust of this disintegrated earth becomes distributed upon plants near the ground, and it is this that animals when folded or penned, and in certain kinds of forage, find the germs of charbon by which they become infected, as in those of our own experiments in which we communicated charbon by directly tainting luzerne. In these results, what openings for thought upon the possible influence of soils in the etiology of diseases, upon the possible danger from the earth of cemeteries, and upon the usefulness of cremation!

Will not earth worms bring to the surface of the ground other germs which would be no less inoffensive to these worms than those of charbon, and yet bearers of diseases affecting animals? In fact they are constantly filled, and with all kinds, and those of charbon are really always associated with germs of putrefaction and septicæmia.

And now as to the prophylaxis of the charbonnous disease, is it not naturally indicated? We should endeavor never to bury animals in fields intended for forage crops, or which may serve for folding (or penning) sheep. Whenever it is possible the ground for burials should be siliceous or sandy; calcareous, but very poor; dry, or easily dried; in a word little suited to the existence of earth worms. The present eminent director of agriculture, M. Tisserand, recently said to me that charbon is unknown in the *savarts* of the champagne. I have no doubt that this should be attributed to the fact that in these poor lands the thickness of the arable soil is only 15 to 20 centimeters (6 to 8 inches) covering a bed of chalk, where worms cannot live.

It is desirable that careful statistics be collected from different countries, from localities where charbon prevails, and those where earth worms are found. M. Magne, member of the academy of medicine, assured me that in the Aveyron, the sections where charbon is met with, the soil is argilo-calcareous, and that those where charbon is unknown have schistose or granitic soils. Now I have heard it said that in these latter sections worms live with difficulty.

In closing this communication I shall venture to say that if farmers desire it, the charbonnoous disease will soon be only a souvenir for animals, shepherds, butchers, tanners in cities, because charbon and malignant pustule are never spontaneous; that charbon exists only where it has been deposited, and where the germs have been disseminated with the unconscious complicity of earth worms; that finally, if in any locality the causes which preserve it are not maintained, it will disappear in a few years.*

Since 1876, a very able veterinarian (Petit) demonstrated that the *mal de montagne* was nothing else than charbon, a result lately confirmed in the remarkable administration reports by M. Maret of Sallanche In the Cantal it is well known that these pastures that have been preserved for time immemorial, that there are those where the disease prevailed at one time or another; finally, that there are places where cattle are so frequently decimated, and that they are designated under the name of *montagnes dangereuses* (dangerous mountains), mountains often abandoned without securing the slightest profit from them, at least for several years, says M. Baillet.

This latter circumstance is worthy of great attention. It proves that the cause of charbon, whatever it may be, disappears with time; we have had several examples of this in our researches at Beance. M. Bautet, the veterinarian so well known in that country, called our attention to *champs maudits* (cursed, dreadful, or horrible fields), where proprietors asserted that charbon was the inevitable consequence of folding sheep there, so that folding has been prohibited for some years past, that is, since the occurrence of the last deaths upon these fields. Now flocks of sheep were placed upon five or six of these fields and the mortality has been *nil*, except for one of the flocks in which it was one per cent.

Later, M. Pasteur presented the following brief paper before the *l'Academie des Sciences des Paris*, on the etiology of charbonnous affections:

> In a paper I lately read before the Academy, in my own name, and that of MM. Chamberland and Roux, I presented a collection of results, giving the key to the etiology of charbonnous affections in countries where this disease is enzootic. To sum up in a few words, a charbonnous animal is buried; the parasite causing the disease and filling the blood is propagated in the earth surrounding the cadaver, and is there reduced to the state of germs. They would be inoffensive if they remained within the earth, but earth worms bring them from below to the surface. Then rains and operations of culture distribute them over plants, or, under favorable circumstances, water carries them to the streams. As a consequence, these germs of disease pass into the bodies of animals, and there develop the infectious parasite.
>
> I am strongly desirous of supporting these principles with as many proofs as possible, in order that all minds, even those most prejudiced in favor of the spontaneity of contagious diseases, shall be obliged to accept them.
>
> Two years ago charbonnous epizootic appeared among the cows of a small village in the department of the Jura, which the disease had not visited for a long series of years. It was, in all probability, introduced by a cow coming from the Upper Jura, which was charbonnous, without the knowledge of the butcher who brought it.
>
> In a slightly inclined field of several hectares, three cows dead from charbon, in the month of June, 1878, had been buried in separate places, six feet deep. The localities of the graves are still perfectly apparent from two physical signs: small crevices found about the earth covering the graves limit them as by circles; besides, weeds grow more thickly upon the graves than in the rest of the field. Finally, it may be noted that at variable intervals of some months we collected either mellow earth or excreta of earth worms from the surface of the graves, and that, in all cases, germs of charbon were found present in them, while at only a few meters from these graves they could not be found.
>
> How can it be doubted that cows pasturing in this field would become affected with charbon. But, as everything is worthy of direct proof, we made a small inclosure about one of these graves, and placed four sheep within it. In another similar inclosure in the same field, and ten to twelve feet above the first, where no charbonnous cows had been buried in 1878, we placed four other experimental sheep. The double experiment commenced August 18. On the 25th of August one sheep within the inclosure about the grave died from charbon; the blood was filled with the parasite of the disease. The other experimental sheep remained perfectly healthy. What a striking demonstration of the theory I have just enunciated, and how evident is the prophylaxis of the charbonnous affection!
>
> Permit me, before closing, to make a further statement. I am prompted also with the aid of MM. Chamberland and Roux, to verify the very extraordinary facts recently announced to the academy by M Toussaint, professor at the Veterinary School at Toulouse. From numerous experiments, leaving no room for doubt, I can assure you that the interpretations made by M. Toussaint are subject to criticism.

---

* See the work published by M. Baillet ten years ago, upon the pastures of Auvergne, which produce what is called in that country *mal de montagne* *mountain disease* (*Memoires du Ministère de l'Agriculture*, 1870).

Neither do I agree with M. Toussaint upon the identity which he declares to exist between acute septicæmia, and chicken cholera. These two diseases are entirely different.

STATEMENT OF M. BOULEY.

Apropos of the preceding note of M. Pasteur, M. Bouley presented the following observations:

I shall take advantage of the occasion offered by the communication of M. Pasteur to present to the academy some information relative to the experiments now being made by M. Toussaint. The academy will doubtless recall the fact, that after the opening of the sealed package, in which M. Toussaint described his process for preventive inoculation against charbon, M. Marey having asked how M. Toussaint interpreted the mode of action of the liquid with which he vaccinated sheep, I replied that in the communication of M. Toussaint there were two questions to be separately considered—that of fact and that of interpretation. Upon the latter there could be differences of opinion, but if the other were established, and shown by experiment to be rigorously exact, this would practically be the principal thing; and after all, this question was no clearer than that of the mode of action of vaccine as preventive to variola, but the benefit of its preventive action is none the less on this account.

Since the primary facts collected by M. Toussaint in his laboratory seem to me to demonstrate that he had succeeded in vaccinating sheep, I asked the minister of agriculture, and received his gracious assent, to authorize M. Toussaint to make a test of his vaccine upon twenty subjects of the Alfort flock. Of the twenty animals submitted to the test, four died in the first four days, and their autopsies showed that the cause thereof was charbon. It proved that the liquid for vaccination was not destitute of bacteridia. M. Toussaint, in presence of this fact, which he learned on his return from Cambridge, stated his reservations at Rheims, before the members of the association for the advancement of science, where the interpretation admissible by the action of his vaccinating liquid was offered.

Once acquainted with the process of M. Toussaint, M. Pasteur on his part caused experiments to be made by his colaborers at the normal school (for its verification). He even made some himself in the Jura, and had the delicacy to abstain from all detailed criticism in order to leave to M. Toussaint perfect freedom of action.

Whatever may have been the nature of the liquid used by M. Toussaint in the preventive inoculation of charbon, I consider that the facts already determined authorize the admission that this inoculation is really preventive; or, in other words, that by means of it sheep which have resisted its action are endowed with immunity from it. Thus M. Toussaint actually has at Toulouse ten sheep and one rabbit that are invulnerable to charbon. At Alfort, of seventeen sheep surviving vaccinating inoculation, two have been inoculated with very active charbon with no visible effect. An experimental rabbit, inoculated with the same virus, died. Here are, therefore, thirteen subjects actually testifying to the preventive properties of inoculations made after the manner advised by M. Toussaint. These experiments are to be continued with the other vaccinated sheep, and there is very strong presumption that they will recover like the first two, because, like them, they were sick in consequence of the reputed vaccine virus.

If all these animals resist the test of charbonnous inoculation, to which they will be submitted, the experimental question will be definitely settled in the direction asserted by M. Toussaint; that is, of absolute immunity by preventive inoculation.

The practical question still remains, that of application of vaccination to flocks, to render them proof against charbon in countries where the disease prevails. To make vaccination practicable, one condition is indispensable: the activity of the preventive virus must be maintained in its preparation to such an extent that it will always produce favorable effects; or, in other words, that the disease produced may be supported by system, and that the animal may recover from it. This is the problem to be resolved by experiment. When this resource once becomes practicable, agriculture will be saved from great losses, and will be deeply indebted to science for another valuable service.

On account of the interesting fact of the complete immunity from charbon in lambs born of mothers inoculated during the last months of gestation, I imagine that when preventives against charbon shall have become practicable it will be possible to produce, not only races, but generations refractory to charbon. We know from the experiments of M. Chauveau that if the Algerian races are refractory to charbon, to the extent of resisting it, the effects are not apparent, but after inoculation are transformed into elevation of the bodily temperature, enlargements of the ganglia, and even in some subjects by dullness, want of appetite, &c. These are the signs of bacteremic infection in a medium unfavorable to the development of bacteridia. Now, none of these signs appear in lambs born of a mother inoculated during the last period of gestation, and in them, therefore, inoculation remains absolutely sterile. Their organism acquired immunity at the same time as that of the mother, for it is remarkable th if the refractory Algerian sheep are sensitive to the first charbonnous inoculation, the become insensible to all others. This also is shown by the experiments of M. Cha veau.

This being true, and supposing that we are in possession of an inoculating liquid accurately measured in its intensity that it would perform the office of a true vaccin nothing would be simpler than to practice preventive inoculation upon the mothe in the last period of gestation. We should thus kill two birds with one stone. In oculation of the mother would be preventive for herself and her fetus, and when th latter comes into the world it will find itself, as it were, naturally protected again charbon. These hopes are authorized, and I, for my part, have great faith in thei realization.

ON THE PRODUCTION OF CHARBON BY PASTURES.

M. Poncaire submitted the following paper:

I consider it important to publish at once the primary results of experiments that propose to follow out, because they are so closely allied to the communication latel made to the academy by M. Pasteur.

On an isolated farm in the neighborhood of Nancy nineteen horned cattle died in th course of three weeks. M. Tisserand, veterinarian, having remarked that the vege tation of the meadow where the farm animals were pastured was constantly mois ened by a liquid having a marshy appearance, thought that there might be found th cause of this local epizootic, so much the more since absolute isolation of the flo would seem to exclude all other modes of production. He urged the farmer not to p his animals in the pasture. Another veterinarian who was consulted advised not kee ing the animals stabled, but allowing them to range constantly in open air. The a plication of this latter advice caused the appearance of three new victims.

M. Tisserand sent me at the same time samples of the water of the pastures and the blood of one of the dead animals. In the first of these liquids I found bacter similar to those contained in the blood, but I considered it of importance to apply th test of physiological experiment.

On June 30, 1880, a subcutaneous injection of water from the pasture was made in guinea pig. It became ill on July 2 and 3, and died during the night of the 3d to t 4th. Its blood, examined microscopically, showed parasitic alteration described Davaine, and on July 5 was injected into a second guinea pig, which died during t night of the 5th to the 6th. The autopsy and microscopic examination demonstrat the charbonnous nature of the affection to which it had succumbed.

NATURE OF THE IMMUNITY OF ALGERIAN SHEEP FROM CHARBON.

A. Chauveau presented the following interesting paper on the imm unity of Algerian sheep:

The question enunciated in the title of this note is one of the most interesting I ha followed in my experiments upon Algerian sheep.

I first endeavored to determine whether or not this immunity is congenital. F this purpose it was only necessary to inoculate lambs that had just been born, and this way I became satisfied that immunity prevails at the moment of birth, this vie being unanimously confirmed by the facts I have observed in this paper. I shall co fine myself to a statement of those furnished by the third lot in my experiments Algiers, whose history I am now able to complete.

The animals in question were four "*suitées*" ewes that had just dropped lambs. In oculated at the same time as their mothers, the lambs received subcutaneous injection of charbonnous material proportionally stronger than those administered to the ewe and the lambs resisted as well as the mothers, and even better. In fact, one of th latter died, while all the lambs survived, after showing transient uneasiness. It wa very remarkable that this uneasiness was most marked in that lamb whose mothe died. This lamb had prostration, diarrhea, more fever than the others, and at on time its condition appeared serious; yet the animal completely recovered before th ninth day, when its mother died. So that lambs when scarcely born are already possession of this precious aptitude for resisting charbon; and further, when this a tribute shows signs of diminishing, it is because the mother enjoys very greatly dimi ished immunity. Congenital immunity of Algerian lambs therefore clearly appears be a maternal heritage. Must we then conclude that this is a family characterist created with the race at the same time as the other characteristics constituting it At one time I thought not, but I was authorized to believe on some accounts that th special immunity now in question is not an innate characteristic belonging to the race, but rather one acquired by all individuals subject to Algerian conditions. The prevailing idea which induced this work led me to the conclusion that under these conditions sheep may abundantly and incessantly find mild germs of bacteridia, which, by developing in the animal organism, produce immunity from the action of the true charbonnous bacteridia, and that this influence is possibly exerted upon the fetus during its intra-uterine existence.

But the results of careful experiment showed the necessity for abandoning this hypothesis. The only infallible means for establishing its value was to determine the influence of the Algerian conditions upon European animals transplanted there; whether by sojourn and repeated reproduction under these conditions exotic races lose their well-known aptitude for acquiring charbon, or at least if this aptitude is sensibly modified. I had an opportunity for procuring at Algiers two subjects which were perfectly suited to the experiments indicated.

These subjects belonged to a flock of merinos that had been kept for a dozen years on a farm in the commune of Rouiba, at the entrance to the plain of Mitidja. The flock had been formed with stock animals from the state sheepfold, long since established at Ben-Chicao. The stock sheep were descended from merinos brought from Rambouillet, and were considered by the owner as being thoroughbreds. He could at least affirm that under his care they had never been crossed with the sheep of the country. My two subjects, fine yearling lambs, were descendants of the fourth and fifth generations from animals bought at Ben-Chicao; and they could therefore be considered as thoroughly acclimated, and completely impregnated by the Algerian conditions in which the family had lived and developed.

On Friday, April 2, these two subjects were inoculated at the same time as three experimental animals, one goat and two rabbits. They were inoculated under precisely the same conditions as the Algerian sheep whose history has been recalled and completed above. This inoculation gave the clearest results, causing all the animals devoted to the experiment to die from charbon. One of the two sheep died on April 4, thirty-three hours after inoculation, and the other succumbed eight to ten hours later, during the night of the 4th to the 5th of April. The bacteremic infection was plainly characterized in both, showing them to be endowed in the highest degree with the aptitude for contracting the infection.

This experiment should have been repeated, but the results it gave are so clear that it is impossible not to consider it a sufficient proof of the impotency of the Algerian conditions to communicate immunity from charbon to French sheep.

After this second experiment we cannot escape the consequences of the first, *i. e.*, the necessity for considering the immunity of Algerian sheep as a race characteristic. We are at least forced to admit that Algerian sheep have an innate aptitude special to themselves, which gives them the ability to acquire this immunity from the Algerian conditions. It may possibly be better to accept this latter view provisionally, that is, to consider as innate the aptitude for acquiring immunity, than the immunity itself. Before finally leaving the habitual influence of the Algerian conditions upon the preservation, or at least upon the formation of this immunity, we should determine what would happen when Algerian sheep are transported to a new medium. Now, certain clinical facts communicated to me by M. Delorme seem to lead to the conclusion that this immunity diminishes when Algerian flocks have been imported to Provence and kept up there for a long time. Experimental demonstration will quickly determine what we should accept, but in the mean time prudence counsels not passing in our conclusions the limit just indicated.

It now remains for me to examine whether among the Algerian sheep, which up to the present we have only considered in a general way, and with regard to the character of nativity, some of the races are more or less privileged. I may say *de visu* that this indigenous population is altogether very homogeneous. In the greater part of Algeria sheep are remarkable for the identity of the fundamental characters they present, and these characters are found in every section of the Sahara boundary. It will readily be understood how this cannot be otherwise, when it is known that the flocks, whose breeding and care are generally in the hands of Arabs, are submitted to continual moving from south toward the north and from north to south. Variations in types in the provinces of Algiers and Oran are insignificant, but in the province of Constantine they are more marked. The western section bordering on the province of Algiers has a dense population similar to that of the latter province, shown in the immense flocks now quasi sedentary of the tribes of Abd-el-Hour. With M. Chevalier I may point out as special families the Amérias to the southeast of Constantine and the Sahalias of the border regions. But the most important peculiarity to be noted is found in the eastern section of the province, bordering on Tunis. This region is stocked with a broad-tailed race called Syrian sheep (*moutons Syriens*), better known in all countries under the name of *moutons tunisiens* (Tunisian sheep), or *barbarins*. Sheep with true (*lipomateuse*) tails exist only in this part of Algeria. Everywhere else sheep have finer tails to a greater or less extent, and this character is all the more marked as we mov towards the west.

Nowhere in Algeria, properly speaking, are pure or grade sheep of the Soudan rac to be found. We must go as far as El Goliah to study these singular animals.

The Algerian sheep, upon which I experimented in France, all came from the neighborhood of Phillipeville; they were more or less pure Syrian or Tunisian, and Abd-el Hour sheep. Among those of my experiments at Algiers, some were born in th plain of Mitidja, others came from Aumale, some had been bought at Djelfa, and th finest came from the neighborhood of Tiaret. I was unable to determine any difference in the aptitude of these several races. Among the number were two sheep havin some merino blood. The special characteristics were not visible in the fleece, but the were perfectly clear. Now these two subjects resisted perfectly the inoculations o charbonnous blood to which they were subjected.

En résumé, all sheep indigenous to Algeria enjoy, to a more or less marked degree, immunity from charbon, and may communicate it to European sheep by crossing.

This property is congenital and natural.

Families of French sheep bred in the Algerian climate do not acquire it; but it i not yet proven that Algerian sheep, bred in a French climate, cannot lose it. We cannot therefore deny the influence of the Algerian climate and surroundings, at least upon the preservation of immunity, as the African sheep clearly prove.

Subsequently A. Chauveau presented the following paper, giving additional important results:

The determination of the fact to which I now call attention, dates back to the tim of my first experiments in the inoculation of bacteremic diseases in Algerian sheep. I had already noticed last year (*Bulletin mensuel de Médecine et de Chirurgie*, 1879, p. 869), that certain *malaises* (morbid symptoms) were especially marked at the time o first inoculation in subjects successively inoculated several times, but my later experiments showed definitely that the attenuation of the effects of subsequent inoculation is due to a truly preservative action of the former. At the moment of writing thes lines the number of animals upon which this study has been made exceeds sixty, al of which have been inoculated at least three times, and half of which have been submitted to from five to eight successive inoculations. My observations are therefor amply sufficient for the demonstration of the augmentation of immunity from charbo in Algerian sheep by preventive inoculations. This demonstration I called attentio to in my communication of June 28.

The best process to follow in observing the influence of a first inoculation upon th results of subsequent ones, is to make the first by subcutaneous injections in one ear. The second inoculation is then made in the other ear, and the others either in both ears or in a totally different part of the body. It is also important to make all with the same infecting material, that is to say, from the same source and of the sam activity, for example, fresh blood of rabbits or Guinea pigs, to which the virus ha been communicated by successive transmission.

What are the effects produced by the first inoculation? It must be understood tha I discard the possible and necessarily very rare case of death of the subject from charbon caused by inoculation. A certain number of subjects lose their vivacity and appetite, and it is thus easy at first sight to determine that the inoculation has made them ill. Others more numerous still continue to eat and ruminate like healthy animals, and seem to entirely escape the action of the infecting agent. But this is of no account, because close observation shows the evident existence of general and local troubles common to all inoculated animals, whether they present external symptoms of disease or not; these are elevation of the temperature of the body and tumefaction of the lymphatic ganglia receiving the affluent vessels about the inoculated region.

Tumefaction of the lymphatic ganglia is an almost constant effect of inoculation, but this effect is more or less marked according to the subject. In a lot of animals inoculated in the same manner, and with the same substance, we find subjects in which this symptom scarcely appears, and others, on the contrary, in which it is strongly marked. When the inoculations are made in the ears it is the parotid and prescapular ganglia that become tumefied. If, as I have recommended, the inoculation is unilateral, the comparison of ganglia with those of the opposite side admits of a much more ready appreciation of the condition of those which have become diseased. We may thus determine that the volume of these ganglia is sometimes five or six times greater than in the healthy condition, and this enormous increase is especially observable in the prescapular ganglia. This is exactly what happens in French animals, whose death from charbon almost inevitably follows inoculation.

This tumefaction of the ganglia does not generally develop with great rapidity. It scarcely begins before the third day after inoculation, and only attains its maximum towards the sixth or seventh day. Its decrease is generally slow. I have seen animals in which this tumefaction was still apparent one month after inoculation.

Elevation of temperature, which always accompanies the evolution of a local process is, like the latter, more or less marked. The two phenomena often follow a parallel progression; that is to say, elevation of the general temperature of the body is more marked in subjects whose ganglia have become very voluminous. A still more constant relation exists between the figure for temperature and the intensity of the apparent diseased condition. Subjects which are morbid and without appetite always have a higher temperature, and a sensibly accelerated pulse and respiration. The rectal temperature, which normally is about 39°.5 C., easily reaches 41° C., and may even pass 42°. This elevation begins to become manifest twenty-four to thirty-six hours after inoculation, and continues three to six days.

Thus, even upon the refractory subjects of Algeria, inoculation of charbon always produces appreciable effects, tumefaction of lymphatic ganglia near the inoculated region, elevation of the general temperature, with or without external symptoms of the disease, such as prostration and anorexy.

Let us now see what happens when, all phenomena of the first inoculation having disappeared, a second is made, followed by several others. The consequence of these new inoculations in no way resemble those of the first; and the animals seem to be in no way affected by this new contact with the infecting agents of charbon. This harmlessness is especially striking in those animals which the first inoculation affected. Not only do these animals maintain their vivacity and appetite they lost at the time of first inoculation, but further, no appreciable enlargement of the ganglia occurs; one scarcely has time to determine the prompt and fugitive elevation of the rectal temperature.

A certain length of time must intervene in order that the first inoculation may exercise its preventive influence with reference to subsequent inoculations. When reinoculation is done too soon, its effects are generally purely and simply added to those of the first inoculation. After the sixth or seventh day the influence of the first inoculation is already evident; but it is especially after the fifteenth day that this influence is clearly established.

Repetition of inoculation has always seemed to give renewed assurance of the increase of natural immunity. Even now I have Algerian sheep which, from June, 1879, to April, 1880, have been submitted to seven or eight inoculations. Those upon which it is practiced now remain absolutely unaffected.

Previous inoculations exercise an inhibitory influence, more especially with reference to subsequent inoculations of the same nature. I mean by inoculation of the same nature those made by the same process, and with the same quantity of the infecting virus. Yet inoculation by pricking the skin, several times repeated, is often sufficient to neutralize to a large extent, if not completely, the effects of inoculations by subcutaneous, or even intravascular injections with quite large quantities of the virus.

All these facts are certainly very interesting, but the most interesting fact that should result from my experiences upon preventive inoculations of Algerian sheep is probably that still remaining for me to mention.

In all the lambs lately born we observe the same phenomena after bacteremic inoculations as in adults; sometimes apparent disease, always elevation of rectal temperature, and more or less evident tumefaction of the lymphatic ganglia near the inoculated region. Now, none of these phenomena are manifested if the mother of the young lamb has been inoculated several times during the last months of gestation. The resistance of the young subject is then as complete as possible. On the 24th of September, 1879, I determined this fact for the first time on a lamb born on the 9th of a mother which had been inoculated on the 5th and 21st of July preceding. Literally covered with punctures of inoculation, this lamb showed no traces of tumefaction of the ganglia nor elevation of rectal temperature. Exactly the same was true of two other lambs whose mothers had been inoculated three and four weeks before delivery, with notable quantities of virus, introduced by subcutaneous injections.

From this fact flow consequences of great importance for the theory of immunity communicated or augmented by preventive inoculations. As M. Davaine has so well shown, the bacteremic *bâtonnets* do not multiply in the blood of the fetus, even when they are found in prodigious quantities in the blood of the mother. Besides, the normal solid elements of the blood do not generally pass from one vascular system to another. Only the sanguinous plasma may be subject to active osmotic exchanges between the mother and the fetus. We may therefore conclude with regard to preventive inoculations of charbon: 1st. That direct contact of the animal organism with the bacteremic elements is not necessary to the ultimate sterilization of this organism. 2d. That preventive inoculations act upon the *humors*, properly so called, rendered sterile or sterilizing, either by the subtraction of substances necessary to bacteremic propagation or rather by the addition of matters injurious to this propagation.

NATURE OF THE IMMUNITY OF ALGERIAN SHEEP FROM SANG DE RATE (CHARBON).

P. Pourquier, an eminent French veterinarian, addressed the following communication to the Academy of Sciences in reply to the statement of M. Chauveau:

I. In a note addressed to the Academy of Sciences, M. Chauveau says the importance attaching to the special question of immunity from charbon in the ovine species is fully appreciated. If it be a race characteristic it would be of great value to clearly establish it, as much on account of the special applications that may be made of the knowledge of this peculiarity as with regard to the general scientific conclusions that may be drawn from it. If this immunity is acquired, a knowledge of it will be all the more important, for the determination of conditions unfavorable to the propagation of charbonnous bacteridia in sheep. Great good would result from the discovery of these conditions, for it would admit of producing immunity at will, since there is every reason to believe that the nature of the conditions would be such that they could be experimentally reproduced.

Notwithstanding our desire to confirm our observations by laboratory experiments, the facilities were not at our command. My opinion is therefore based entirely upon practical data secured under the exceptional circumstances by which I have been surrounded. These data are annually secured from three thoroughly distinct groups of animals; these are—

1. Algerian sheep (to the number of 10,000 to 12,000 per year) sacrificed at the city abattoir, a few days after their arrival in France.
2. Algerian sheep bought in August by our breeders at Marseilles or Cette. These animals, before entering into public consumption, are fattened from four to six months.
3. Pine or crossed Barbary sheep born in France, composing many of the flocks that have been bred in our country from time immemorial.

Since all these animals reach the abattoir, I therefore make fifteen or twenty thousand autopsies every year.

These are the elements to which my attention has been directed, especially since M. Chauveau raised this very important question of immunity from charbon.

In the first note addressed to the Academy of Sciences, in September, 1879, he asks himself the question whether the immunity of Algerian sheep from bacteremic inoculation should be considered as an accidental characteristic belonging to certain individuals, or as a general characteristic common to all Algerian sheep brought to France, and he thinks that on account of their unanimity the facts plead in favor of the latter opinion.

Experiments made in Algeria by this savant showed that this immunity was far from common to all sheep raised in that colony.

Long before the result of these experiments were known to the public I had, in a letter addressed early in April, 1880, to M. Delamotte, a distinguished veterinarian of the army of Africa, formulated the probable results that should be obtained in the experiments in inoculation of charbon made upon Algerian sheep. My prediction was formulated thus:

1. Algerian merinoes will succumb to inoculation.
2. *Narrow-tailed* sheep will show less immunity than broad-tailed animals.

In a memoir of M. Delamotte, recently published by the *Bulletin de l'Association Scientifique Algérienne*, 1880, pp. 98, 99, we read: "Constantine sheep, called '*barbarins*,' and recognized by their broad tails, exhibit greater immunity than those of the province of Algiers having narrow tails." And further, "merino races imported to Algeria in 1868, and very nearly pure, do not seem to exhibit the slightest immunity. Absolutely like French sheep, Algerian sheep die almost immediately after bacteremic inoculation: they are carried away on the second or third day."

My predictions of the month of April are therefore entirely confirmed, and if I have now decided to communicate what I believe to be the principal cause of immunity from charbon it is because I was convinced that the beautiful researches undertaken by one so learned as M. Chauveau would lead to this discovery.

II. Immunity from bacteremic inoculation exhibited by many Algerian sheep is intimately allied with a peculiar anemia by which they are attacked. All practical men know that a distinct antagonism prevails between cachetic affections and charbon, and that animals of vigorous constitution are a more easy prey to the attacks than others. A cachetic animal placed in a field where other animals die from charbonnous fever is never attacked by it.

If a flock of sheep be decimated by charbon, the only efficacious means for effecting a disappearance of the disease is to place the animals in condition favorable to the *development of* aqueous cachexy. When the latter becomes marked, the animals may be placed upon charbonnous lands without hesitation, and the disease in question will not appear. These are facts of common observation, and their application has long since been practiced by shepherds and able breeders.

"The influence of cool moist places is so marked," says M. Bouley, "that farmers do not hesitate to buy flocks exposed to or already attacked by charbon, persuaded that by pasturing them upon swampy lands they will arrest the progress of the disease; in fact, a few days of this regime is sufficient to modify the economy, diminish the plethoric condition, and restore to the blood the water lost by healthy, abundant, and substantial feeding."

"The anemia of Algerian sheep differs essentially from hydrohemic anemia as well known in France, and designated as aqueous cachexy, gamadure, rot, &c. While this latter is especially characterized by the existence of distoma in the biliary ducts, by infiltrations to the cellular tissue, &c., we see that in anemic Algerian subjects there is no appearance of distoma in the liver, and not the slightest infiltration; the muscles instead of having a fine red tint are rose-colored. This muscular decoloration is particularly manifest on the surface of the broad subcutaneous muscles covering the abdomen and thorax; of a very pale wine-yellow in Algerian sheep; this muscle has a beautifully bright carmine tint in the plethoric French sheep. The flesh of anemic Algerian sheep is not very nutritive, and gives to *pot-au-feu* (a dish of soup and boiled meat) a clear, almost white, soup; roasted, the juice is pale, colorless, and watery.

Algerian anemia is by no means rare or exceptional; on the contrary, it is very common. The eight or ten thousand broad-tailed sheep (Barbarins and Barbarin-syrians) slaughtered at Montpellier a few days after landing, during the summers of 1879–1880, were all more or less anemic. Anemia was also very common among narrow-tailed sheep, but in this variety a goodly number of subjects were found whose muscular coloration is equal to that of our finest French sheep.

Anemia seems to be unfavorable to the propagation of charbonnous bacteridia, and it is this that gives immunity, as is proven by the following facts from practical observation:

A large number of breeders in the Herault during the month of August buy African sheep for fattening, which is generally completed in the course of six months after their arrival in France. When the sheep are anemic on arrival (which is the general rule at that time), not the slightest trace of charbon can be found; but it is manifest later on if the constitution of the animal has been modified by rich and abundant food.

It has always seemed to me that the plethoric condition is more rapidly developed in narrow-tailed African sheep than in broad-tailed ones. Muscular coloration is produced more slowly in the latter, but when produced, as it is in barbarins born and raised in France, the charbonnous affection quickly appears, since the animals are placed under conditions favorable to the development of charbon.

IMMUNITY FROM CHARBON ACQUIRED BY PREVENTIVE INOCULATIONS.

H. Toussaint, whose investigations and important discoveries have attracted great attention here as well as in Europe, submitted the following paper on the importance of inoculation for charbon:

The numerous experiments I have made in later years upon charbonnous diseases have convinced me that bacteridia, when introduced into the economy of animals susceptible of contracting charbon, do not find absolutely normal conditions, though their development always takes place with fatal effect in French races of sheep, and in rabbits. They grow slowly, however, as is proven by the fact that in the tissues or liquids of the animal they never pass through the complete period of development—*they never yield spores, and their multiplication is always effected by division of mycelium.*

On the other hand, certain animals never contract charbon, though their vital conditions appear similar to those of species which take the disease with the greatest ease as, for instance, swine. Finally, other animals easily become charbonnous in youth, and lose this faculty on arriving at puberty, or in old age; such are dogs, horses, mules, &c., among which young subjects always succumb to inoculation, while later on large numbers resist it.

M. Chauveau has even shown that in a race of Algerian sheep the greater proportion of animals is refractory to bacteremic infection.

These different observations gave me the idea of attempting to place the organism in such condition that bacteridia will no longer find it suited to their development, and to this end I have made numerous experiments. After several unfruitful trials, I finally succeeded by a very simple means in preventing multiplication of bacteridia in young dogs, and in sheep; in other words, I can actually vaccinate sheep so that they resist inoculations and intravascular injections of considerable quantities bacteridia; and these bacteridia may be in the state of spores, and obtained by c ture, or in a state of short chains, as they are found in the blood of animals just de

The following are the details of the experiments thus far completed, and whi fully confirm the assertion I have just made:

Dogs.—I am assured that dogs, up to six months after birth, easily contract charb by simple punctures, and that they die, showing large quantities of bacteridia in t blood, with simultaneous local lesions, and lesions in the ganglia, of an extrem grave character.

Eight young hunting dogs, from three mothers, were submitted to experime Four were vaccinated by the process I adopted, and four were not. I had chosen animals in such a way that in each lot there were brothers of those in the other.

The four vaccinated animals resisted four successive inoculations by punctures, by subcutaneous injections of charbonnous blood.

The four not vaccinated succumbed to the first inoculation in two and four da with considerable œdema about the point of inoculation; the nearest ganglia h increased to ten or fifteen times its primitive volume; it was crowded with bacterid whose number in the blood surpassed that of the globules.

At the first inoculation of charbon the vaccinated animals had slight fever, and two there was slight œdema at the point of inoculation. The other inoculation pu tures behaved like simple sores.

Sheep.—They all belonged to the Lauraguais race, in which so-called spontane charbon often made serious ravages. My experiments were made upon eleven of th animals. Five were inoculated with charbon *only once*, but at different times, and di in two or three days. Besides, throughout the three years of my experiments, I ha never seen a sheep of this race, when used, resist bacteridia, whatever may have be the quantity inoculated.*

The six remaining animals were preventively inoculated. After a single vacci tion two were inoculated with charbon, and one of them died with the ordinary ch acteristics. The five remaining I vaccinated anew, and after about a month submitt each of them to three subcutaneous inoculations with charbonnous blood from do rabbits, sheep, and one inoculation with spores, inducing neither local nor gene symptoms.

The absence of the local symptoms led me to believe that the blood itself was unsui to the reproduction of bacteridia. In fact, I introduced to the facial vein of four these animals two to three drops of rabbit's blood, which, as regards the number parasites, represented for each animal a total of about two hundred millions of b teridia directly introduced to the blood. None of these four sheep exhibited morbid symptoms.

To-day these five animals are perfectly well, and seem in no way affected by the v cination or the different inoculations to which they have been subjected. They be returned to the flock, and I propose to inoculate them from time to time to det mine the duration of this immunity. I am, however, already able to announce tha lasts more than two months; the three dogs and one sheep having been inoculated the first time at the beginning of May, and for the last on the 1st and 6th of July.

---

* Whenever a vaccinated animal was inoculated the activity of the charbon determined by inoculating one or several rabbits with it. These always died

ANTHRAX AMONG CATTLE IN THE NORTHWEST.

Early in February last it was reported that a very malignant and fatal disease, resembling in its symptoms and lesions contagious pleuro-pneumonia, was prevailing to an alarming extent among certain herds of calves imported into Illinois, Iowa, and Missouri from some of the Eastern States. In order to positively determine the character of this malady, which seemed to be causing great alarm among cattle raisers in the Northwest, the Commissioner of Agriculture appointed and directed Drs. McLean and Detmers to at once proceed to the infected localities in the above-named States and make a thorough investigation, by *post-mortem* examination and otherwise, as to the nature and cause of the disease. This they did in a prompt and satisfactory manner. The reports of these veterinarians, which were at once printed and widely circulated by the department, immediately allayed all fears as to the existence of the dreaded lung plague among the cattle of the West. The following is the report submitted by Dr. McLean:

Hon. WILLIAM G. LE DUC,
Commissioner of Agriculture:

SIR: In accordance with instructions received from you, dated 1st instant, requesting me to investigate into the alleged outbreak of contagious pleuro-pneumonia among cattle introduced from the Eastern States into Illinois, Iowa, and Missouri, I, in company with Dr. Detmers, of Chicago, have made an exhaustive examination, and now beg to submit the following report:

On the 7th of February I examined the herds of Dr. Standley, near Bedford, Taylor county, Iowa, who, during the fall of 1880, had purchased something over 200 Eastern calves, and out of which up to this time he had lost some 75 head. On my arrival, I found lying frozen in his yard four calves, which had died on the previous day. A careful *post-mortem* examination of these having been made, unmistakable lesions of anthrax fever (black leg) were found in three, while in the fourth case pulmonary lesions were manifest, both lungs being the seat of lobular pneumonia, the effects of phthisis pulmonalis verminalis, the strongylus micrurus being found in large numbers in the bronchial passages. Upon inspecting the remainder of the herd, the majority of which exhibited an unhealthy appearance, one was selected for slaughter, which was admitted by the owner to be in a condition typical to that of those which had died exhibiting lung disease. The *post-mortem* in this case also showed that the animal had been affected with phthisis pulmonalis verminalis, and exhibited patches of lobular pneumonia.

I then went to Worth county, Missouri, and examined the herd of Mr. McCall, among whose Eastern calves contagious pleuro-pneumonia was reported to have broken out. I found that he had originally purchased 60 of these animals, 7 of which up to date had died. Many of this herd were much emaciated. Upon examining one which I had selected for *post-mortem* examination, the same pathological lesions were found in the lungs as had been exhibited in that of Dr. Standley.

I next inspected the herd of Mr. C. T. Ward, Mormontown, Taylor county, Iowa, who had in September, 1880, himself purchased and brought to his farm from the western part of the State of New York 210 calves, but of which he had to date lost 33. From the description of the symptoms which he gave me as having been exhibited by them before death, I would consider that 28 had been affected with anthrax (black leg), and 5 with some pulmonary trouble. *Post-mortem* examinations were made upon three carcasses, in which I found the same pulmonary lesions as in the calves of Dr. Standley and Mr. McCall.

The lungs of one of these animals I was able to take in a frozen state to Chicago, and the weather being favorable they were taken in the same perfect condition to your department in Washington for examination.

The herd of Mr. I. M. Legg, McDonough county, Illinois, was also examined. Here 77 Eastern calves had been introduced, of which at date 17 had died, as the owner said from some lung complaint. A typical case having been selected, the same pulmonary lesions were found as in the other cases.

In none of the above herds were the external symptoms or physical signs of contagious pleuro-pneumonia present, while in all the characteristic pathological lesions were absent on *post-mortem* examination.

While the present alarm has thus been found to be groundless, too much care cannot be exercised in controlling the movements of cattle and stock cars from our infected Eastern States, so as still to preserve the Western herds from this dread disease.

Very respectfully,

L. McLEAN, M. R. C. V. S.

BROOKLYN, N. Y., *February* 19, 1881.

REPORT OF DR. H. J. DETMERS

Hon. WILLIAM G. LE DUC,
Commissioner of Agriculture:

SIR: In obedience to your instructions of the 1st instant, I made a thorough examination of the herds of Eastern calves owned respectively by Dr. J. R. Standley, in Platteville, Taylor county, Iowa; by Mr. McCall, in Worth county, Missouri; by Mr. Ward, in Mormontown, Taylor county, Iowa, and by Mr. Legg, near Doddsville, McDonough county, Illinois, for the purpose of ascertaining whether contagious pleuro-pneumonia of cattle, as reported, has been imported by or is existing in any of those herds of Eastern calves or not.

There were made in all nine *post-mortem* examinations, six of which on animals found dead, and three on animals killed by bleeding, and also carefully examined numerous living animals exhibiting symptoms of disease. I found in all the animals examined more or less affection of the lungs, and at the *post-mortem* examination more or less morbid changes in the respiratory organs, but found also that none of them were affected with the disease known as contagious pleuro-pneumonia of cattle, or bovine lung plague. Therefore, as far as the present is concerned, all rumors to the contrary may hereby be set at rest.

Very respectfully submitted.

H. J. DETMERS.

OUTBREAK OF ANTHRAX AMONG CATTLE IN NEW YORK.

Before the publication of the above reports, an outbreak of a very fatal disease occurred among cattle in Cattaraugus county, New York. Dr. James Law, of Cornell University, was requested by the Commissioner of Agriculture to make an examination as to the nature of the disease and cause of the outbreak, and report the results of his investigation to the department. The following is his report, which was published simultaneously with the reports of Messrs. McLean and Detmers:

Hon. WILLIAM G. LE DUC,
Commissioner of Agriculture:

SIR: In accordance with your telegram received March 6, I left the same day for Otto, Cattaraugus county, New York, and arrived there the following afternoon, having been delayed somewhat by late trains on the Erie Railroad.

The village of Otto I found to lie on Cattaraugus Creek, three miles northeast of Cattaraugus, the nearest station to the Erie Railway. The farm of Mr. Allen, on which the outbreak of cattle disease had occurred, lies on the high ground to the north of the creek, and about half a mile from the village. It was out of the way of all cattle traffic, and the cattle on the farm had all been raised there, even to the bull, which was one of the common breed, kept for exclusive use of the herd. The conditions furnished presumptive evidence against infection from without, yet the report made by Dr. Lake, of Otto, and the fact that the tenant on the farm was a German, who might have had visits from friends (emigrants or otherwise) carrying with them infected clothing, made it all-important that the case should be fully investigated. The following is quoted from Dr. Lake's report:

"Within from five to eight days Mr. Allen had lost seven cows from a disease unknown to this part of the country. Of the seven cows above referred to I saw four opened on the 27th ultimo, all having the same general appearance. The symptoms of the three cows (seven sick) were as follows:

"The animals appear dull and sluggish, eyes without luster, respiration twenty-five per minute, short, dry cough, froth at the mouth; auscultation and percussion show changes in the lung tissue; the ear applied over the chest detects an absence of the natural soft breathing murmur, and in its stead a loud rasping sound, with crepitation and all the symptoms of pneumonia.

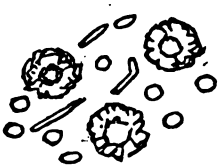
"Result of post-mortem examination of a cow that died this a. m. (March 2): The cavity of the chest contained from three to four pints of yellowish-green liquid, colored with blood. Both lungs diseased, the left more than the right, and weighed fifteen pounds; solid, firm, and resistant, and appear to be very much enlarged. The right lung of a deep-red color throughout, and elastic, and does not crepitate on pressure; the left lung covered with very dark red and black spots, and appears to be completely hepatized. The gall bladder appears to be very much distended and enlarged. This examination * * * was sufficiently * [clear] * to satisfy the mind of any medical man that the cow died of pneumonia."

Other reports gave the cases very grave aspect. Mr. Drake, about two miles higher up on the Cattaraugus Creek, and to the northeast of Mr. Allen's farm, had lost a cow within a few days. On a second farm of Mr. Allen's, nearly a mile due east of Cattaraugus, a cow was found dead in the stanchions on the morning of my arrival. On a farm of Mr. Darling's on the high ground to the west of Cattaraugus Creek, and about a mile and a half from the village of Cattaraugus, a cow had died the same (Monday) morning. Two more are alleged to have died within a day or two on the farm of Clark Scott, of East Otto.

Reaching Mr. Allen's farm at Otto, I found that ten cows had already perished in this one herd besides the one on the Cattaraugus place. A number more were sick, some very seriously. Four or five had aborted.

Symptoms.—Temperature in different cases: 107°, 103.5°, 103°, 103°. The affected animal was dull, sluggish, with hind limbs drawn forward, and back slightly arched, as if from abdominal pain; flanks hollow; soft, doughy sensation in the region of the spleen; eyes dull, glassy, and retracted; the visible mucous membranes had a dusky hue; there was much debility, and in several instances the fetal membranes projected from the vulva. In several a fetid diarrhea existed. I learned further, from Dr. Pool, that the dung had been bloody in some of the earlier cases, and that in one case that he had opened a portion of the intestine had been quite filled by a blood clot.

Lesions.—After the above symptoms I was quite prepared to find all the lesions of anthrax. In several carcasses, and in one very sick heifer, killed for the occasion, the lungs were sound with the exception of some emphysema and black spots of blood extravasation. In one animal only, on Mr. Allen's lower farm, did I find them gorged with blood. The spleen was smaller and less engorged than is usually the case in anthrax, not exceeding two pounds in any small two-year-old heifer, but it had a puffy, doughy feeling, which implied the abnormal state of the blood within it. The liver was generally firm and natural in appearance. The bowels, particularly the small intestine and the rectum, were more or less congested, the summits of the mucous folds above all having a very dark-red hue, which was manifestly largely due to blood extravasations. In addition it need only be named that the serous membranes and internal organs generally were more or less discolored by spots of extravasated blood (petechiæ), and that the blood in the heart and large vessels was abnormally dark colored, and fluid, or only partially coagulated into a very loose and diffluent clot. Blood received into a clean, stoppered bottle from the carotid artery of a dying heifer, and examined in the center of the clot 48 hours after, and before there was any sign of decomposition, showed the microscopic characters given in annexed slip. The peculiarities are the staff-shaped and small spherical bodies, and the cremated appearance of the blood globules.



Cremated blood globules, staff-shaped, ovoid and spherical bodies in the blood of Mr. Allen's heifer. March 9, 1881.

Supposed causes.—In seeking to estimate the causes of the outbreak I found that the land was mainly loamy or gravelly, but was underlaid at certain points by a subsoil of *hardpan*, which determined the retention of moisture and favored the preservation of the anthrax germ. The drinking-water was from a spring, and evidently of excellent quality. The barns were fairly roomy and well aired, though when all the herd (39) were indoors in cold weather the air would be a little foul. The recent thaws occurring after an exceptionally severe winter would doubtless operate as exciting causes in inducing a febrile and susceptible condition of the animal's system, and i liberating any existing disease germs that had been previously locked up in frost.

Regarding the introduction of the germ, a presumptive explanation is found in th history of the pigs on the place.

In the course of the last four years as many as 74 pigs have died on Mr. Allen's far at Otto. Precisely how this mortality began I did not ascertain; but, on one or mo occasions, Western pigs were brought in and mostly died. It is further significant th one year Henry Kehler, the tenant, put up a new pig-pen on fresh ground, and f that year he suffered no losses. The second year, however, in the new pens the disea broke out as before, the infection having, presumably, been introduced from the ol pens or other part of the premises. The victims of this swine mortality were some times allowed to lie in the lot adjoining the pig-pen, and just across the road from th barns, until they became very offensive. The hogs were mostly buried on a flat spac where a loamy soil lay over a dense *hardpan*, so that it did not readily dry out, an there was ample opportunity for the preservation of the anthrax germs. The cattl had had access to the lot adjoining the pig-pen, where the dead pigs had been fre quently left. They also received hay from the meadow where the pigs had bee buried. From either of these sources, therefore, they may have received the anthra germs, as in both places those that had been preserved in the depth of the soil wer liable to be brought up and deposited on the surface by the earth-worms. There the could be collected with the hay, licked from the surface of the soil, or blown on th winds to mingle with the food or water.

Prevention.—By way of prevention I recommended the destruction of carcasses b burning, and the disinfection of the barns, pig-pens, and yards with chloride of lim and quicklime, scattered in the yards and applied to the buildings in the form of whitewash, containing a quarter of a pound of chloride of lime to each gallon of wate The buildings were also to be fumigated with sulphur. The manure made for a for night before and for the same time after the outbreak was to be burnt. The graves the pigs were to be carefully fenced in and no hay to be cut from their surfac Finally, the whole herd of cows to be put on the following: Chlorate of potassa, drs.; bisulphite of soda, 4 drs.; carbolic acid, 1 drachm; to be dissolved in water a mixed in the food of each animal every morning. Each sick cow was to take in add tion every night 1 drachm of iodide of potassium and 2 grains bichromate of potass

In conclusion I would remark that this outbreak is to be looked upon as essential a local occurrence, and not likely to spread widely from herd to herd after the mann of an epizootic. From germs left in the soil in different fields a case or two may occ yearly for some time, but with due precaution as regards the sick and carcasses should be entirely extirpated in a short time.

Respectfully submitted.

JAMES LAW.

CORNELL UNIVERSITY, ITHACA, N. Y., *March* 9, 1881.

PREVENTION OF FOWL CHOLERA.

The following circular letter was issued by the Department of Ag culture early in February last:

TO WHOM IT MAY CONCERN.

Although the cholera of fowls is an exceedingly virulent and fatal disease, destro ing vast numbers of birds of different species, and remaining on premises for yea after being once introduced, we are satisfied, after a long series of experiments, th there are points in its natural history which enable us to control it with comparati ease and with a considerable degree of certainty. These points are:

1. *The virus is not diffusible.*—That is, the disease germs are seldom if ever taken u by the air and carried any considerable distance to produce the malady. The vir remains in the fixed form, and is generally, if not always, taken into the body wit the food; it is distributed over the grounds, feeding-places, &c., in the excrement affected birds, and the food, drink, and gravel are thus contaminated. Healthy bir may be kept in coops within a few feet of the sick ones for months without contrac ing the disease; but if the former are now placed in the same inclosure with the latt they sicken in a few days.

2. *The virus must be carried upon the grounds frequented by fowls before they contract t disease.*—It is not probable that this disease originates, in any considerable number cases, in any other way than by contagion. There is a possibility that it may orig

nate in occasional instances by filthy surroundings if closely confined, or by feeding on decomposing substances; but there are few facts to support such a conclusion, and it appears certain that in the vast majority of cases the disease is imported and kept up by contagion alone.

It is thus brought upon farms either (1) with sick or infected fowls newly acquired, (2) with the blood or parts of the bodies of dead birds carried on the feet of people or brought by dogs or other animals, (3) with infected manure or feathers, or (4) possibly by wild birds, animals (rabbits), or even insects that have contracted the disease or have eaten the blood or bodies of affected birds recently dead. The origin of the disease can generally be traced in country districts, where houses are a considerable distance apart, to recently-acquired poultry. It is only in districts more thickly peopled, and then in exceptional instances, that the germs are carried by wild birds or animals or by insects.

PREVENTIVE MEASURES FOR GROUNDS ALREADY INFECTED.

1. *Is the disease cholera?*—Fowls frequently die in considerable numbers from diseases that are not contagious, and hence it is a matter of primary importance to decide as to the nature of the affection when cholera is suspected. In my own experience I have found that this might be done with comparative certainty by inspection of the excrements. With fowls the excretions of the kidneys are joined in the cloaca with the undigested parts of the food, and both solid and liquid excrement are consequently voided together. They are not mixed to any great extent, however; the part excreted by the kidneys is easily distinguished, as during health it is of a pure white color, while the bowel discharges are of various hues. The kidney excretion will be hereafter referred to as *the urates*, and it is the only part which claims our attention.

After a fowl takes the contagion into its body the first and only reliable symptom is a coloration of the urates. At first these have only a faint yellow tint, which rapidly change, however, into a deep-yellow color; up to this time the bird shows no other signs of the disease, its temperature is unchanged, and its excrement of a normal consistency. In one or more days after this yellow color appears the urates are greatly increased in quantity and constitute the whole or a greater part of the discharges, and an obstinate diarrhea sets in; in a few cases the urates now become greenish, and exceptionally they are of a deep-green color.

The only lesion seen in *post-mortem* examinations that is likely to attract the attention of non-professional observers is the enlarged liver, which is nearly constant; it may be of various shades of color. Besides this, the presence of yellow urates in the cloaca and ureters is a valuable sign, and is generally present.

2. *Sick birds must be destroyed.*—The excrements of sick birds are the principal means of spreading the contagion, and the first step in stamping out the disease is, consequently, to destroy all which are voiding yellow urates. Care should be had to make the distinction between the urates and the bowel dejections, for the latter are frequently of a yellow color in health; but a little observation will preclude any mistake of this kind. The killing should not be by any method which allows the escape of blood, as this fluid is even more virulent than the excrement; wringing the neck is a quick and easy method of destroying the life. Once killed, the bodies are to be taken beyond the limits of the poultry run and deeply buried.

If it is decided to keep the sick birds till they die or recover, they should be placed in an inclosure by themselves, as far as possible from the healthy ones, where they may be cared for without entering, so that there will be no danger of carrying particles of the excrement on the boots and spreading the infection.

3. *Healthy birds must be placed on disinfected grounds.*—If a piece of land is at hand to which the sick birds have not had access and which is consequently free from the contagion, the healthy birds should be penned upon it; but if all of the land is infected, then a piece is to be selected and thoroughly disinfected with the solution mentioned further on in this paper. The fowls are to be restricted to this disinfected ground for several months, or even a year or more, if practicable. The drinking-vessels and feeding-troughs are to be new, or, if used before, they must be soaked for twelve hours with the same solution before being placed in the new inclosure.

4. *Observations to be continued to note the first reappearance of the disease.*—Some of the fowls, though well at the time of removal to disinfected quarters, may be infected with the disease, and after the period of incubation, which varies from three to twenty days, will sicken. It is necessary, therefore, to make a careful inspection of the excrement each morning for at least three weeks after the separation of the sick fowls. If yellow urates are discovered, the birds must be watched until the sick one is detected. To facilitate the early discovery of such sick fowls and prevent infection of the healthy ones it is advisable, where practicable, to separate the birds into lots of two or three each at a start; and this separation may always be practiced as a last resort where the disease successfully defies our efforts for a considerable time; but where this is impossible a little patience will generally enable one to pick out the sick before

any harm has resulted. As soon as the sick bird is removed, the excrement must
scraped up and burned, and the run must be again sprinkled with the disinfectan
or, the well birds may be changed to fresh ground as before. This method of ma
agement is to be continued as long as new cases of the disease occur.

By a careful observance of these rules one can frequently check the disease, with
loss of but one or two fowls out of a large flock.

5. *Disinfection.*—For this disease we have a very cheap and most effective disinfectan
It is a solution made by adding three pounds of sulphuric acid to forty gallons
water (or ¼ lb. of acid to 3⅓ gallons of water) and mixing evenly by agitation or sti
ring. This may be applied to small surfaces with a common watering-pot, or to larg
grounds with a barrel mounted on wheels and arranged like a street-sprinkler.
disinfecting poultry-houses the manure must be first thoroughly scraped up ar
removed beyond the reach of the fowls; a slight sprinkling is not sufficient, but tl
floors, roosts, and grounds must be thoroughly saturated with the solution, so that
particle of dust, however small, escapes being wet. It is impossible to thorough
disinfect if the manure is not removed from the roosting-places.

Sulphuric acid is very cheap, costing at retail not more than twenty-five cents
pound and at wholesale but five or six cents; the barrel of disinfecting solution ca
therefore, be made for less than a dollar and should be thoroughly applied. It mu
be remembered, too, that sulphuric acid is a dangerous drug to handle, as when und
luted it destroys clothing and cauterizes the flesh wherever it touches. The safe
way is, therefore, to take a five-gallon keg nearly full of water to the druggist ar
have him place the strong acid in this; the contents of the keg may then be safe
transported and added to the barrel of water.

6. *Fumigation.*—In those cases where the disease has been raging for a considerab
time the feathers become saturated with the contagion, and it is necessary, befo
placing the fowls on the disinfected run, to put them in a close building and thorough
fumigate them with sulphur. For this purpose a pan of burning coals is taken ar
flower of sulphur thrown upon them as long as the air can be breathed witho
danger of suffocation. When the disease is recognized at the outset this is not nece
sary.

PREVENTIVE MEASURES FOR GROUNDS NOT YET INFECTED.

1. *Newly-acquired birds to be isolated.*—When cholera is raging in a locality, all bir
introduced from other flocks should be placed in an inclosure by themselves for
least three weeks, until it is certain that they are free from the disease. No fow
should be accepted from a place known to be infected for at least a year after the la
known cases occur.

2. *Precautions in regard to eggs.*—All eggs from a distance to be used for hatchi
must be thoroughly cleaned of all particles of excrement adhering to them, and t
water with which they are washed, as well as cloths or brushes used, must be rais
to the boiling point before being thrown upon grounds to which poultry has acce
The virus is always destroyed by a boiling temperature, or even by 140° F., if mai
tained for fifteen minutes.

3. *Fowls not to wander upon adjoining infected premises.*—A stone wall is, in tow
frequently the boundary line of an infected place, and though fowls are upon ea
side of it the contagion may not cross for years. In such cases it is a matter of t
greatest importance to prevent the healthy fowls from trespassing upon the infect
grounds.

4. *Fowls from neighboring infected premises to be rigidly excluded.*—If it is important
keep healthy fowls from infected grounds, it is not less important to exclude fow
living in infected quarters from entering on runs that are still free from the disea
Even though insusceptible to cholera and, consequently, healthy, they are able to car
the virus on their feathers and feet, and may even distribute it with their own exc
ment; for although the virus is unable to propagate itself in the blood and tissues
insusceptible birds, there is reason to believe that it may still multiply in the conten
of their digestive organs.

5. *Other infected substances to be excluded from the runs.*—Manure from infected plac
is often purchased and spread upon land to which healthy poultry has access and th
becomes a means of spreading the disease. This should either be entirely exclud
from the farm or the fowls should not be allowed to come near where it is placed.
cannot be safely disinfected. Feathers and dead birds are also at times carried a co
siderable distance by various agencies and should be guarded against when possib

By a careful observance of these rules the fowl-cholera may be excluded indefinitel
and may be exterminated when it has made its appearance. The writer has had
very virulent form of the disease among experimental fowls for nearly eight mont
and though his home flock is but a short distance from them, but a few of these ha
sickened, and then the disease has been checked, with the loss of a single bird in ea
instance. It is believed that the birds which thus contracted the disease were infect
by flies, which would gorge themselves with virulent blood in the laboratory, whe

dissections were made, and then fall victims to the poultry which were running about outside. No cases have occurred in this manner since the cold weather has destroyed these insects.

The experiments on which the above regulations are founded will be detailed in future reports of this department; they are sufficiently numerous to be worthy of the fullest confidence.

The value of the method of preventive inoculation or vaccination discovered by Pasteur has not yet been decided, but in view of the comparative ease with which the affection may be controlled by the measures detailed above we doubt if it can ever be advantageously adopted as a means of preventing this particular disease.

D. E. SALMON, D. V. M.

ASHEVILLE, N. C., *February* 18, 1881.

OUTBREAK OF ANTHRAX IN NEW MEXICO.

Hon. WILLIAM G. LE DUC,
Commissioner of Agriculture:

SIR: In compliance with the instructions contained in your orders dated March 31, 1881, to proceed to Topeka, Kans., and obtain from the authorities there such information as was possible regarding an outbreak of supposed contagious disease among cattle in the Pecos Valley, New Mexico, and then to proceed there and make such examination as would be necessary to enable me to determine the nature and extent of the said outbreak, I beg to submit the following report:

On my arrival at Topeka I placed myself in communication with the State agricultural department and Mr. J. G. McCoy, special agent for the Census Bureau, from whom I obtained such information as they possessed. After a complicated and tedious journey I arrived at Fort Sumner, and upon inquiry among several ranchmen there learned that the seat of the outbreak was among the cattle upon the ranch of Mr. J. S. Chisum, about 100 miles further on, to reach which necessitated thirty-six hours' more driving.

Mr. Chisum is the reported owner of 70,000 head of cattle, and his ranch is the largest in New Mexico. It is situated about 300 miles down the Pecos Valley. Upon my arrival I found ample evidence of the mortality that had existed among his stock, as in a place of 4 miles by 2 there were the carcasses of no less than 200 cattle of various ages, and those of 30 horses. These had in death assumed many different attitudes; some lying upon the sternum and abdomen with the legs extended from under the body, others upon their backs with the legs up in the air, while all presented the appearance of having died in great agony, or in a state of delirium.

Unfortunately I arrived too late to witness and note the symptoms, as by this time there were none acutely affected, but I saw several which were convalescent, two of which were destroyed and *post-mortem* examinations made upon the bodies.

The owner, who has had a large and varied experience among the cattle both of Texas and New Mexico, was at a loss to account for the unusual mortality, as hitherto upon this ranch the annual death rate would not reach one-half of one per cent., and gave the following history of the outbreak:

The great majority of the cattle are grazed upon the east side of the Pecos River, where the pasture is of a superior quality; along the west bank the land at a certain point is very low and flat, and cut up in many places by large tracts of marsh and swamps, which at one point are so disposed as to form a natural corral, capable of holding and feeding a limited time 1,000 head of stock, and which is frequently used for t purpose when drafting cattle.

During the month of October Mr. Chisum became aware that th was some trouble among the cattle upon the west bank of the riv Although there were no deaths and the majority was thriving well, s eral seemed depressed, but from all other parts of the ranch the cow-b reported perfect health.

About the 1st of November last Mr. Chisum rounded up a numbe his stock in order to select 300 beef cattle which he had to deliver d ing the month of December, bringing a large number from the east s from which to select suitable animals for this purpose, and thus larg increasing the stock usually kept in this swampy region. As the n essary cattle were selected they were placed in this natural corral, rest being left grazing around in the marshy region. During the ha ling and excitement entailed by drafting the cattle many of them be to exhibit the following symptoms: An inclination would at first noticed to lag behind the herd; a watery discharge would appear fr the eyes, and a profuse perspiration would break out over the fore qu ters, the animals seeming drowsy and trembling. If still driven a excited, diarrhea would set in, the excretions being bloody. Sympto of paralysis beginning to be manifested, the animals would become lirious and soon die in great agony.

The horses grazing in the same place were affected and manifes similar symptoms. This condition of matters lasted from Novembe the 1st of February, when the majority of the cattle were removed fr this district, after which no deaths or sickness occurred, the cow-b reporting the stock all healthy. After delivering the beef cattle at agency several seemed depressed, but no serious sickness or death reported, nor did they in any way affect the other cattle among wh they were placed.

Mr. John Miller, a small ranchman in this immediate vicinity, lost of a hundred head ten, but at once removed his stock to another local after which no deaths occurred.

Having obtained the above history of the outbreak, I proceeded in saddle, with the aid of a guide, to examine the cattle upon the ran and as excitement was reported to have more rapidly developed train of symptoms, I had several hundred head of cattle rounded and driven rapidly for several miles, but failed to produce any mark effect.

A few animals known to be convalescent were pointed out, and w the owner's consent were shot.

The *post-mortem* examination developed nothing, with the excepti of a few ecchymosed spots upon the internal surface of the stoma and large intestines, all the remaining viscera being in a normal c dition.

In endeavoring to form a diagnosis of the trouble which affected th cattle it is to be noted that the summer of 1880 was, in this distri exceptionally dry, many of the large swamps referred to above havi been dried up, a layer of saline substance in places four inches thi being deposited upon the surface from which the water had disappeare also during the months of August and September very heavy rainfa occurred, the Pecos River overflowing its banks and inundating all t low swampy land upon which the cattle were for the time being round up. The animals fed exclusively upon the rank herbage found upon t *marsh land*, and were limited to the use of the water of the swamps.

From these facts and the symptoms shown by the affected cattle there can be no doubt that this was an outbreak of anthrax, which was caused by miasmatic infection from decomposing organic matter contained in the soil and water of this region. The injurious influence exerted by this was aggravated by the excessive quantity of saline substances present, which greatly favored the organic decomposition.

As a preventive measure the owner was recommended to avoid grazing in this district under similar circumstances.

Upon my return from the Pecos Valley, in accordance with your instructions I visited the authorities of the State Agricultural College at Manhattan, Kans., and placed myself at their disposal to endeavor to ascertain the causes of the large mortality in various sections of the State from black-leg.

I here learned that for some time there had been no serious outbreak of this disease in the State. I visited in this and other sections several farms upon which black-leg had formerly been more or less prevalent. Upon them the causes and conditions favorable to the production of this disease could be readily observed in the formation of the soil and the peculiar water supply. Thus on those farms situated in low-lying districts, where are found a tenacious subsoil and no natural drainage, the mortality from this cause, especially among young cattle, is, in wet seasons, very large, while upon elevated farms with a more porous subsoil and natural drainage, and spring or pump water for the use of the cattle, this disease is of rare occurrence. Although large numbers of cattle in Western Kansas died from the severity of the winter and the scarcity of fodder, yet I found in this State a complete absence of contagious disease among horned stock.

Although I inspected many thousand hogs and made extensive inquiry in every section of the State visited, I failed to find or hear of a single case of hog cholera.

Very respectfully,

L. McLEAN, M. R. C. V. S.

BROOKLYN, N. Y., *June* 1, 1881.

NON-EXISTENCE OF FOOT-AND-MOUTH DISEASE IN THE WEST.

Hon. WILLIAM. G. LE DUC,
Commissioner of Agriculture:

SIR: I arrived at Chicago on my return from New Mexico on the 6th of May, and there found the instructions contained in your letter of the 2d ultimo, requesting me to trace to the premises and districts from which they came the bulls shipped prior to April 15, by Mr. Talbot, of Chicago, to Messrs. Hathaway & Jackson, Brighton, Mass.; also the cattle shipped to Portland, Me., for R. Craig & Co., of Canada, by Messrs. Adams & Eldredge, about the 1st of March, last, with the view of determining whether epizootic aphtha has or does exist among the cattle in the stables from which these animals were taken, and also to inspect the stock-yards and cow stables in Chicago, for the same purpose.

Of the 54 bulls sold to Hathaway & Jackson by Mr. Talbot, 26 were shipped from Chicago on the 22d March, and 28 on the 7th April. They were fed by himself at the United States Distilling Company's sheds, on Twenty-seventh street, and were five and a half months in his possession, during which period they are said to have been in perfect health.

They were weighed at the Chicago stock-yards, and stood there for t days before being shipped.

I immediately examined the stables from which they came, and t cattle in and around them, but failed to detect any symptoms of e zootic aphtha, or to learn that it had recently affected any of the sto

Messrs. Adams & Eldredge, who shipped the stock for R. Craig Co., informed me that these cattle had been grain-fed, that they ca from Gibson City, Ill., and were purchased by them in the stock-yar where they stood for forty-eight hours before being shipped. I trac these cattle to the farms from which they came, and examined the pre ises they had occupied and the stock with which they had cohabite but could find no symptom of the presence of epizootic aphtha.

I also inspected 1,600 bullocks and 500 milch cows in the distille stables of Henry H. Shufeldt & Co., 23 Larrabee street; 900 bulls a 300 milch cows at the sheds of the Garden City Distillery Compan and upwards of twenty minor cattle stables in and around the city Chicago, without finding a single case of contagious disease.

I visited and inspected the cattle, sheep, and hogs in the stock-yar twice every day during my stay of six days in Chicago. Many of t cattle, especially milch cows and sheep, remain in the yards for sever days, and frequently as long as two weeks, and in several cases t same cattle occupied the pens at each of my visits, but at none could find any animal affected with foot-and-mouth disease.

The opportunity afforded by the thorough commingling of the sto in these yards makes it manifest that should a single case of epizoot aphtha appear, from its highly infectious character many of its victi could be daily seen.

I conversed with several gentlemen, who I personally know to ha been familiar with the symptoms of foot-and-mouth disease in Scotlan who state that no case had ever come under their notice in their distri

I also inspected the stock-yards at Kansas City and Saint Louis, a have no hesitation in saying that epizootic aphtha is still an unkno disease in the Western States.

Respectfully,

L. McLEAN, M. R. C. V. S.

BROOKLYN, N. Y., *June* 1, 1881.

EXTRACTS FROM LETTERS OF CORRESPONDENTS.

Black-leg.—Mr. S. Aldrich, of Wyanet, Ill., says that he has successfully used sulphur and copperas as a preventive of the destructive disease of black-leg among cattle. He mixes with salt, and places in boxes where it will be convenient for his cattle at all times.

Laurel as a cure for swine plague.—Mr. W. J. Medders, of Island Station, Ky., gives the following preventive and cure for diseases of swine:

> I have recently discovered [he says] that laurel (called by many mountain ivy) is an excellent preventive for diseases of swine. The manner of preparing it is as follows: Gather the roots, leaves, or young twigs, and boil them to an ooze; add ship-stuff or corn-meal sufficient to make a stiff dough, salt well, and feed to the hogs. It is wonderful to see the number of worms the animals will discharge after eating this preparation. It makes hogs very sick, but after the effects pass off it leaves them healthy and they fatten very fast. Care should be taken not to feed them too much, as the laurel is poison. By its use it will be found that hogs apparently in good health are full of worms of all sorts, from an eighth of an inch to six inches in length, and in some cases they exist in such large quantities that it is with difficulty that the hog can pass them.

Dust a cause of swine plague.—Mr. A. Harris, of Newbern, Tenn., writes as follows concerning the deleterious effects on swine of inhaling air charged with dust:

> We now have hog cholera in this section. I also hear much complaint from farmers about their hogs being lousy, though their appearance and general condition seem to be very good until they are attacked with the disease. I am of the opinion that sleeping in dry, dusty beds will produce this disease, and that after it has once developed itself it then becomes both infectious and contagious. Some years ago my hogs commenced sleeping under dusty out-houses, and very soon thereafter they were attacked with a cough, which was shortly followed by the appearance of cholera among them. In the early history of this country, when the hogs all bedded in the woods and made good beds of leaves with little or no dust, we had no such disease as cholera. Inhaling dust produces irritation of the lungs, which is soon followed by a cough and hectic fever that eventually assumes a very malignant character.
>
> Some years ago I purchased two fine-blooded pigs, and in order to give them special care I turned them in my yard, and after a short time they commenced sleeping under my house, where there was much dust. They soon began to disturb me by hard breathing and coughing during the night. This gradually grew worse until I removed them to a lot where there was no dust, and in a very short time they were free of the cough and much improved in appearance. After a while I returned them to the yard, and in a few nights thereafter the cough and hard breathing returned and continued to grow worse rapidly until they were again removed from the yard. They were not suffered to return, and soon all symptoms of cough disappeared and good health was restored. During the time they were coughing they showed unmistakable signs of ill-health, and from their drooping and languid appearance, so characteristic of the approach of cholera, I am inclined to the opinion that this disease would soon have developed itself had they been suffered to remain longer in dusty beds. So marked was the effect of dust upon them that the attention of my whole family was attracted to the matter.

Weeds poisonous to cattle.—Mr. C. R. Moore, Johnsontown, Va., writes as follows under date of February 26, 1881:

> In looking over your report for 1879–'80, I noticed the death of some cattle from eating poisonous weeds. Last summer a large number of cattle died in this locality.

Of course their death was attributed to murrain, but at first I thought the tro was caused by drinking filthy water, as the streams were dried up and the wat the holes became very bad by the tramping of the cattle and the wallowing of hogs. The deaths ceased after the heavy rains in August, but the animals comm to die again the latter part of September. I lost four head, and amongst them Devon bull, and also a young Devon bull. The malady seemed particularly fatal bulls. However, I know that so far as my cattle were concerned the trouble was caused by the water, as my creek was a living running stream during the whole son, and the water was good and pure. This convinced me that the trouble w caused by something which the cattle had eaten while the grass was dried up. I w mention that I live on the sea-side, and have both salt and fresh pasture. It m have been the poisonous mushrooms that produced the disease. The cattle will them, but I am not sufficiently acquainted with them to distinguish the poiso from the healthy sorts. As soon as the rains came again the deaths ceased. Alm every summer when the season is dry, the cows now and then eat something wh makes the milk a quick emetic, but after vomiting no sickness or other ill effects a left. The vomiting will occur in about five minutes after drinking the milk. Wh my cattle were first attacked, a man who was pasturing with me removed his anim to an inclosed field, and lost none. The field to which he removed them was lo ground, and had not suffered much by the drought.

DISEASE AMONG CATTLE IN LOUISIANA.—In November last sever cattle died of an unknown disease in the vicinity of Mound Station, L The malady was a very fatal one, and attracted considerable attentio during its prevalence. Dr. A. F. Sampson, who made an autopsy one of the animals that died (a cow), gives the following as the resu of his examination:

General appearance, that of a well nourished cow; tongue and œsophagus norma stomach well filled with food (chiefly grass and a little corn), showing good mastic tion and digestion; mucous membrane softened and easily detached, attributed action of fluids of stomach, as the structure of this viscus was otherwise health The continuation of the alimentary track was closely examined and found to healthy; there was no peritonitis; liver normal; gall bladder well emptied. T other abdominal viscera were in a healthy condition. Lungs strongly adherent thoracic wall; pleura red and roughened; lung consolidated; no crepitation on pre ure; on section of lung found it infiltrated with bloody exudation. The heart w found in a normal condition, except the left ventricle, which contained a firm an mortem clot. This heart clot seemed to explain the sudden death of the animal.

BLOODY MURRAIN.—Mr. Samuel P. Brown writes that a very fat disease prevailed among cattle in Cumberland County, Va., during th past summer, which was regarded by many as the disease common known as bloody murrain. Happening to visit a neighbor who ha just lost an animal by the disease, he proposed a *post-mortem* exa ination, which was readily assented to. In giving the results of th examination Mr. B. says:

I found the liver very much congested; the gall bladder enormously distende almost to bursting; the bowels filled with very hard, dry fecal matter. The stoma was a curiosity, being completely full and closely compacted, and so dry I think could easily have been set on fire. I also examined the kidneys and bladder. The was some congestion of the former, but the latter had a fair normal appearance. pronounced the disease congestion of the liver, and suggested that on the first sym toms in another animal that one hundred grains of calomel be given immediately, be followed in four hours by one pint of castor oil or one pound of epsom salts. I had occasion to try it next day on a valuable cow. She recovered. He told his neig bors of the remedy, and it was soon very generally known. In a few weeks the di ease entirely disappeared. Four-fifths of those treated with the above remedy recovere

Acting upon a suggestion I read in your former valuable report on diseases of a mals, I advised a friend, whose cattle were grazing on his lowlands, and several which had died from apparently the same disease, to remove them to highland pa ture. He did so, and lost not a single animal after the change. Your remedy was t best, for prevention is always better than a cure.

ANTHRAX FEVER.—Mr. Norman R. Wills, writing from Johns county, Tenn., under date of December 20 last, says:

I have been thinking for some time of writing to you in regard to a disease amo cattle that has been prevailing in this immediate locality for some months pa

Calves and yearlings have been dying at a fearful rate—as the hogs died some years ago with cholera. They first commence to droop, complain sometimes, and occasionally manifest lameness. They generally die in about twenty-four hours. We have no remedy. When one gets sick we drive it to a good place to skin, and it is not long thereafter before we get the job. We have had no disease among our cattle since the war until this affection appeared.

A SIMPLE REMEDY.—Mr. J. D. Guthrie, of Shelby county, Ky., gives the following simple remedy for snuffles in sheep and grub in the head:

Snuffles is easily relieved by injecting into each nostril a decoction of tobacco. This is done by emptying the contents of the barrel of a small gutta-percha syringe in each nostril. The head of the sheep should be raised so that the fluid will reach the seat of the disease. I have seen relief given by this remedy when the animal was unable to stand upon his feet. Pulverized rosin with salt (half and half), given once a week, is a preventive of the disease.

For the grub, the same application of tobacco-juice will often relieve the animal. The grub is produced by the gad-fly, which deposits an egg in the nostrils of the sheep from the middle of June until the last of August. This can be prevented by salting the flock in long narrow troughs, previously well painted with pine tar, so that a portion of the tar will adhere to the nose of each animal. The tar is obnoxious to the fly, and will discontinue its annoyances to the flock as long as a particle of the tar remains on the nose.

SPLENIC FEVER.—Dr. W. W. Michaux, of Powhatan county, Va., forwards the following statement relative to the first appearance in that county of splenic or Texas fever of cattle, a disease so well described and exhaustively treated by Dr. D. E. Salmon, in Special Report No. 22 of this department:

The chief disease affecting cattle in this section of Virginia is a very singular one, and is known as distemper, murrain, and a variety of other names, with no reference to pathology. One of the most interesting facts concerning it is, that if once carried to a locality it will attack the cattle there at irregular intervals ever afterwards; another fact is, that it is never seen at any place unless carried there by diseased cattle. Still another anomaly is, that a single fence will divide the infected from the non-infected district indefinitely; but if a single infected animal be allowed to go over into uninfected districts, the district will forever remain infected. There are certain districts in this vicinity where it has never been known, while on this farm it has prevailed off and on for forty or fifty years. The limits are of course extending, the disease invading new districts at almost every recurrence of the epidemic. A variety of remedies have been tried, but better results have been obtained by using, as a preventive, equal parts of lime (slaked), sulphur, salt, and red clay for the cattle to lick. Animals affected with the disease are usually constipated, the urine bloody and the fever high. They will often show fight when suffering with the disease. The contents of the stomach of one animal I opened after death were found to be almost entirely dry.

Cattle raised in the infected localities are much more exempt from the disease than those imported into them, these almost invariably dying during the first epidemic of the malady after their arrival.

I would state that the foregoing is the result of the experience of three generations of my family living in this immediate vicinity, and that I can remember when the disease was first introduced into the neighborhood.

MILLET DANGEROUS FOOD FOR CATTLE.—Mr. J. O. Baxter, of Ringgold county, Iowa, writes that a number of cattle died in that county during the past winter, their death supposed to have been the result of feeding on millet. Milch cows seemed to be more readily and seriously affected by this diet than other animals.

PREVENTIVE FOR SWINE PLAGUE.—Mr. R. McEnesy, Chico, Cal., writes as follows under recent date:

I cannot tell you how, or why, sulphate of copper (commonly called blue-stone) cures so-called hog cholera, but I know practically that it does. During the past five years I have tried it repeatedly on my own and neighbors' hogs, and have not failed in any case where the animal was not virtually dead. If generally used as a preventive this disease would soon be known only in memory. As you have the best opportunity of making known this remedy, will you please have it tried, and if foun good recommend its use? Give in feed or drink at the rate of one pound of sulphat to five gallons of water. As a preventive one feed a month will be found sufficient Keep all other animals from it.

THE WAY SWINE PLAGUE IS SPREAD.—A correspondent at Springfield, Clark county, Ohio, writes that the farmers of that county organized an institute in February last. At this meeting the lung disease o cattle was discussed, and Congress petitioned to pass stringent laws t prevent the spread of this dreaded disease in the United States. Prof E. W. Claypole, of Antioch College, read a paper on swine fever, an gave strong proof that transporting dead hogs to rendering houses wa a fruitful means of spreading the disease. Irresponsible men, with bu little means for gaining a livelihood, were engaged in hauling thes dead hogs, and their trade depended on the spread of the disease.

HIGH FEEDING RECOMMENDED.—Mr. W. E. Grant, Carroll county Kentucky, writes as follows concerning the feeding of stock for market

> The most experienced stock growers here are convinced of the importance of having all kinds of stock mature at as early a period after birth as possible. To accomplish this they keep as much good food before their young animals as they will consume from the time they are willing to eat until they are sold. Hogs should be eigh or nine months old when sold—that is, pigs dropped in February or March shoul never want for food, but should be kept fat until sold in December. Lambs droppe in February are ready for market in June. It is well to hasten them on by feedin cracked corn with the meal sifted out. There is no danger of young animals eatin too much if their food is kept where they can get at it at will. Cattle are no exception to this rule, and should be fed high to return the greatest profit for the food consumed.

IMPORTANT SUGGESTION.—Mr. W. Miller, 687 Broadway, New York writes as follows under date of March 17 last:

> The recent investigations of the Department of Agriculture on contagious diseas of domesticated animals, especially with reference to pleuro-pneumonia of the bovin aphthous foot-and-mouth disease, and other kindred diseases, has led to the propriet of including in these researches contagious diseases in the human family, to discove for instance, if a preventive for scarlet fever is not to be found in the aphthous foo and-mouth disease, and if the purified virus of pleuro-pneumonia of the bovine ca be applied under certain conditions to the human family, as in vaccination, as a preventive in phthisis pulmonalis.
>
> It has been proven that diseases of domesticated animals can be communicated t human beings with safety, and give protection for a specific disease. If a preventiv is discovered that contains within itself a mild and effective means that will give immunity or lessen the severity of a disease that is either contagious or non-contagiou and applied as in vaccination, it is of the same importance to the human family a the bovine creation.
>
> From practical experience in collecting the animal or bovine virus from the calf f vaccination as a preventive in small-pox, I find neither heat, cold, nor infiltratio changes the character of a virulent poison. But when diffused or passed through a animal membrane from one to the other, the virulence of the poison is lessened of i contagious properties. While the portion which does not pass through still retains i it can then be used with harmlessness and without danger, if not with complete immunity; as a preventive in all cases it lessens the severity of a disease and arres the life of the patient.
>
> It is now well understood that the influence of one poison has the power of neutra izing or destroying the action of another. This is proven in vaccination for small-po and of the negro or Cholo in Mexico, who inoculates himself with the poison of the serpe with the tooth of a rattlesnake, which renders him safe from the bite of all venimo animals. Traussea perpetuated the records of the brave old pioneer of vaccinatio Benjamin Jerty, who long before Jenner discovered and reasoned out the cow-pox a a means of producing immunity from small-pox, and applied the discovery to his ow family. The most difficult question that now confronts the medical profession is th which relates to the prevention of disease, and it is said there is more of science i preventing or lessening the severity of a disease than in trying to cure it.

SPLENIC FEVER.—Mr. J. L. Hale, of North Salem, Lynn county, Missouri, writes as follows under recent date:

> During the month of March two of our citizens went to Texas and brought back with them about 150 head of Texas steers. They were landed at Moberly, Mo., and afterwards brought up into this county. About 85 head were turned on to the prairie, where they were allowed to run at large. A very fatal disease has since appeared among our native cattle, which we think is Spanish fever. About 200 head have already died, and a great many more are sick.

CONTAGIOUS LUNG PLAGUE OF CATTLE.—Dr. Chas. A. Leas, Emory Grove, Baltimore county, Maryland, says:

> The diseases prevailing among cattle and other domesticated animals are seriously damaging our agricultural interests. I have suffered severely, as I informed you last year, from the effects of contagious pleuro-pneumonia among my cows. The disease is still prevailing in our State.

PREVENTIVE FOR SWINE PLAGUE.—Mr. H. O. Dixon, of Jackson, Miss., gives the following preventive measures for swine plague:

> In the report of your department for 1878, Dr. Vogler, in speaking on the subject of hog cholera, says: "No remedy was discovered having any marked beneficial effect upon the disease when once fully established." This is fully in accord with my own experience, but I believe I have discovered a preventive which will stop the spread of the disease in a herd after it has made its appearance; at least it has been successful in every instance when tried by myself and others. I feed my hogs with shelled corn or oats scattered on the ground, and while they are eating I sift fresh air-slacked lime over them until the hair is filled and the ground covered with it. Whether it is the lime inhaled or that swallowed, or both, that produces the desired effect I am unable to say, but it has proved effectual. This preventive I accidentally discovered during the war, and since using it I have never lost a sound hog by the disease. Previous to the discovery of this preventive the disease prevailed among my hogs, but I checked it by feeding sorghum cane.

REMEDY FOR BLACK-LEG.—Mr. H. M. Kemp, of Schuyler, Colfax county, Nebraska, gives the following remedy for the destructive disease generally known throughout the country as black-leg:

> I see from special report No. 12 of your department, and other publications, that black-leg prevails among young cattle in many localities in this State. I am surprised that a remedy used forty years ago is not better known by stockmen of the present day. I have been engaged for forty-five years past in breeding and rearing stock, and in all my experience with this disease I have never known it to fail in a single case. The disease appears among my cattle almost every spring, but as yet I have not lost a single animal. The remedy consists of one pound each of saltpeter and common salt, ground and well mixed. One-half teacupful dry is given at a dose. After this, severe exercise should be given, lasting for twenty minutes. A second dose is seldom required.

WOOD ASHES AS A PREVENTIVE OF SWINE PLAGUE.—Mr. J. B. Hunter, of Kittrell, Granville county, North Carolina, editor of the Roxboro' Herald, writes as follows relative to the value of wood ashes as a preventive of swine plague:

> I have been fond of raising hogs all my life, and have always had pork or bacon to sell. I never fattened a hog on a floored pen; always make the floor over my hogs; The general objection to this is that the hogs will eat dirt. My reply is that a hog only eats dirt when it is necessary for its health, and if wood ashes are kept in its trough this necessity will never arise, nor will it ever have the cholera. What is known as cholera is nothing less than worms, and these worms are destroyed by the wood-ashes. My observation has been that hogs that have not received regular supplies of wood ashes while fattening are full of worms. They may be found on the intestines and around the kidneys, when killed; the liver is generally diseased and unfit for use. My hogs are always free from these worms, and I am satisfied it is owing to the liberal supply of wood ashes I keep by them, and compel them to eat by feeding on the ashes. Those of my neighbors who have adopted the use of ashes testify with me that they have lost no hogs by cholera since they commenced the use of this cheap and simple preventive.

WOOD ASHES AND SALT AS PREVENTIVES FOR SWINE PLAGUE.—R L. M. Berry, of Salisbury, Mo., writes as follows under recent date:

> While I live in this town I travel over the State a great deal. Mr. E. F. Lyon Pettis county, Missouri, informed me recently that he is an extensive swine rai feeding generally of his own raising on his farm near Longwood anywhere from f to five hundred hogs annually. He has not lost a hog from the diseases which af swine for a number of years, and feels no uneasiness about his own animals when so-called cholera is in the neighborhood. He feeds his hogs every morning wit small feed of shelled oats dampened with water and then mixed with ashes and s He uses from twelve to fourteen barrels of salt per annum in feeding in this w Before adopting this plan he says he suffered great losses from hog cholera and ot diseases, but he has not lost an animal during the five years he has been practic this system. His neighbors, who do not use these precautions, are continually suf ing losses among their swine. Mr. Lyon is a reliable gentleman and thrifty farn and thinks his system of feeding will prove very valuable if generally known.

REPORT OF THE PRIVY COUNCIL OF GREAT BRITAIN.

The annual Report of the Veterinary Department of the Privy Council office of Great Britain for the year 1880 has just been published. From this report it would seem that notwithstanding the restrictions on the foreign-animal trade were rather more severe and exacting in some respects than they were in 1879, yet the importations of live stock increased in 1880 as compared with the previous year. The total number of imported animals from all countries out of the United Kingdom was 1,379,838 against 1,241,847 in 1879. From European countries, exclusive of the Channel Islands, were received 180,877 cattle, 797,482 sheep, 37,907 swine, against 143,187 cattle, 750,469 sheep, and 32,591 swine in 1879.

From Canada there were received 48,103 cattle, 78,074 sheep, 671 swine, against 25,185 cattle, 73,913 sheep, and 3,663 swine in 1879.

From the United States were received 154,814 cattle, 66,722 sheep, 12,549 swine, against 76,117 cattle, 119,350 sheep, and 15,180 swine in 1879.

From the Channel Islands the importations were 2,632 cattle against 2,151 in 1879, and from other countries 6 cattle and 1 sheep against 12 cattle, 22 sheep, and 7 swine in 1879.

From Ireland were received 721,391 cattle, 714,763 sheep, 372,890 swine, against 641,370 cattle, 673,371 sheep, and 429,663 swine in 1879.

The total number of animals imported into the island from all sources in 1880 was 3,188,882 against 2,986,251 in 1879.

The report gives the following statistics of the cargoes of foreign animals in which disease was detected:

> There were landed in Great Britain during 1880 from places out of the United Kingdom, exclusive of the Channel Islands, 3,392 cargoes of animals consisting of 383,800 cattle, 942,279 sheep, and 51,127 swine. In 151 cargoes the inspectors detected disease among the animals on landing in this country. The diseased cargoes came from the following countries: Belgium, 38 cargoes, of which 3 cargoes, consisting of 582 sheep, contained 33 sheep affected with sheep-scab; Denmark, 525 cargoes, of which 2 cargoes, consisting of 343 cattle and 77 sheep, contained 5 sheep affected with sheep-scab; France, 42 cargoes, of which 3 cargoes, consisting of 174 cattle, contained 40 cattle affected with foot-and-mouth disease; Germany, 482 cargoes, of which 18 cargoes, consisting of 20,878 sheep and 701 swine, contained 5 sheep and 15 swine affected with foot-and mouth-disease, 3 sheep affected with sheep-pox, 248 sheep affected with sheep-scab, and 3 swine affected with swine fever; the Netherlands, 684 cargoes, of which 10 cargoes, consisting of 821 cattle, 5,143 sheep, and 354 swine, contained 2 cattle affected with pleuro-pneumonia, 2 sheep affected with foot-and-mouth disease, and 10 swine affected with swine fever; Portugal, 93 cargoes, of which 1 cargo, consisting of 96 cattle, contained 4 cattle affected with foot-and-mouth disease; Spain, 317 cargoes, of which 1 cargo, consisting of 52 cattle, contained 5 cattle affected with foot-and-mouth disease; Sweden, 140 cargoes, of which 1 cargo, consisting of 97 cattle, 4 sheep, and 22 swine, contained 3 sheep affected with sheep-scab; Canada, 211 cargoes, of which 2 cargoes, consisting of 108 cattle and 226 sheep, contained five sheep affected with sheep-scab; the United States of America, 770 cargoes, of which 110 cargoes, consisting of 26,464 cattle, 12,931 sheep, and 5,013 swine, contained 229 cattle affected with pleuro-pneumonia, 21 cattle, 63 sheep affected with foot-and-mouth disease, 124 sheep affected with sheep-scab, and 403 swine affected with swine fever.

The following record of casualties is made up from the returns f nished by inspection at the ports named where American and Canadi animals were landed during the year:

From Canada there were imported in 1880 to the ports of Bristol, Glasgow, Liv pool, London, and Southampton, 211 cargoes of animals, consisting of 48,103 catt 78,074 sheep, 671 swine, in addition to which 813 cattle, 1,747 sheep, and 5 swine w thrown overboard during the voyage; 53 cattle and 100 sheep were landed dead, a 38 cattle and 110 sheep had to be slaughtered at the place of landing owing to injur received in transit.

From the United States there were imported in 1880 to the ports in Barrow-in-F ness, Bristol, Cardiff, Glasgow, Hartlepool, Hull, Liverpool, London, South Shiel and Southampton, 770 cargoes of animals, consisting of 154,814 cattle, 66,722 she and 12,549 swine, in addition to which 6,831 cattle, 2,964 sheep, and 1,359 swine w thrown overboard on the voyage; 168 cattle, 108 sheep, and 111 swine were land dead, and 104 cattle, 45 sheep, and 81 swine were so much injured that it was nec sary to slaughter them at the place of landing.

Thus it will be seen that 13,619 animals were thrown overboard du ing the voyage, 540 were landed dead, and 384 were so much injured exhausted that they had to be killed at the place of landing, making total loss of 14,543 animals. The losses, however, were not so severe in the previous year in proportion to the number of animals shipped.

During the year the disease of contagious pledro-pneumonia exist in 51 counties in Great Britain, the number of outbreaks being 1,0 against 1,549 in 1879. The number of cattle attacked during the ye was 2,765 against 4,414 in the previous year. In England alone t disease existed in 37 counties, and 967 fresh outbreaks were report during the year.

GENERAL CONDITION OF FARM ANIMALS.

ALABAMA.

Chilton County.—Hogs and fowls have been seriously affected with cholera during the past year. But slight losses have occurred among horses and cattle.

Cleburne.—Cattle are quite frequently attacked by distemper, of which some die. Hogs are more or less fatally affected every year with cholera or red mange. Some seasons the cholera destroys almost all the fowls in the county.

Conecuh.—Large numbers of horses die for want of proper care and attention. Cattle have suffered from severe cold weather, and many have died in the woods or on the range for want of food. In some parts of the county hogs are annually afflicted with cholera. Very few recover from this disease. Fowls die by the hundreds of a similar disease.

Crenshaw—Fowls have died off very rapidly during the year. An examination shows a greatly enlarged liver, for which reason we call the disease cholera.

Elmore.—Distemper is about the only infectious disease that is ever troublesome among our horses. A few hogs die annually of cholera. Fowls have been largely affected with a similar disease and the loss has been quite heavy.

Franklin.—The principal losses sustained by farmers of this county during the year have been occasioned by diseases affecting swine. Some cattle and a good many fowls have also died of diseases common to them.

Lowndes.—Almost every horse in the county is now suffering with the epizooty, but in a mild form. Cattle have no contagious disease, but large numbers of them die every year from being eaten or bitten by ticks which multiply in the fall season. This species of ticks was unknown here until about three years ago. Fowls are afflicted with the disease known as chicken cholera, from which large numbers die annually.

Madison.—Chicken cholera is the only disease from which we have sustained any loss during the past season, and it has not been so destructive as in former years.

Randolph.—The epizooty prevails among horses, murrain and black tongue among cattle, cholera among hogs, rot among sheep, and cholera among all kinds of fowls. Our losses have been quite heavy for the year.

Wilcox.—Horses here are subject to such diseases as blind staggers, big head or big shoulder, and blindness. My experience and observation lead me to the belief that about four-fifths of the horses of the county are attacked by one or the other of these diseases before they arrive at the age of maturity. These diseases quite often prove fatal.

Winston.—The so-called cholera has prevailed to some extent among swine in this county during the year. It has been of rather a mild form and as yet has done but little damage.

ARKANSAS.

Benton County. I estimate the losses among farm animals in the county during the past year as follows: Horses, $10,000; cattle, $[illegible]; hogs, $[illegible]0,000; sheep, $500; fowls, $2,000.

Bradley. The only disease prevailing among our horses is epizootic distemper, from which but few animals have died. Some hogs have been lost by the usual disease—cholera, so called.

Clay. A number of cattle have recently died in this county of a disease unknown to us. Some hogs have also been lost, supposed to have been caused by kidney affection or by eating mast infested by worms.

Crittenden. Two or three thousand dollars will cover all the losses occasioned by disease among farm animals in this county during the past year. No disease has prevailed in an epidemic form.

Cross. We have lost some cattle in this county during the past season by distemper and dry murrain. The hog cholera has been more destructive than usual. This disease usually destroys about half the hogs in the county. Sheep are subject to distemper, which frequently proves fatal. As in the case of swine, chicken cholera kills about one-half the fowls in the county.

Dorsey. Epizootic influenza has been prevailing among our horses and mules for some weeks past. Some animals have died. Our losses have been quite heavy among cattle and hogs. I estimate the losses of the former at $5,600, and of the latter at $3,500.

Faulkner. A very fatal disease has prevailed among the hogs in the county during the past winter. It made its first appearance in the western part of the county, and extended east and north. In some localities it has destroyed almost every animal. The symptoms of the disease were those of pneumonia. I examined a great many, and without exception found the right lung inflamed; in many cases both lungs were affected. The animals would live from three to ten days. They had but little appetite, but were very thirsty.

[illegible] What is known here as hog cholera is the [illegible] most [illegible] disease [illegible] class of farm animals. [illegible] extent than the [illegible] years past.

[illegible]

Ouachita.—All classes of farm animals in this county have remained unexceptionally healthy during the year. In different localities fowls are badly afflicted with cholera, a disease which seems never to prevail two years in succession in the same locality.

Pope.—The principal disease to which our horses are subject is blind staggers. This disease attacks so suddenly, and kills so quickly, that there is no time for applying remedies. Cattle are frequently afflicted with either dry or bloody murrain, a disease which can be cured, if taken in time, by the administration of a drench of peach-tree juice. Hogs die at a rapid rate of swine plague, and many sheep are lost by rot. Chicken cholera is quite prevalent, and a great many fowls die annually of the disease.

Prairie.—The only contagious diseases prevailing among any class of farm animals in this county is epizootic distemper. Chicken cholera prevails at some points in the county every summer. I never knew a fowl afflicted with the disease to get well.

Scott.—Cholera has prevailed with its usual virulence among hogs and fowls during the past year. Horses have been afflicted with distemper, of which some twenty-odd animals have died.

Sevier.—The epizooty has prevailed among horses to a limited extent. Cholera and measles killed a number of hogs some time since, but recently these animals have remained healthy.

Sharp.—The only infectious or contagious disease that has prevailed among farm animals in this county for several years past is cholera among hogs. This disease prevails more or less every year.

Union.—Our horses are suffering with a distemper which, so far, has done but little damage. Hogs occasionally have cholera. When my neighbor's hogs are suffering with this disease mine are healthy, and *vice versâ.* We cannot account for the vagaries of the disease. Fowls also suffer with cholera, but the disease does not prevail among them every year.

Washington.—Texas fever has visited some herds of cattle in this county during the year. There has been some loss of hogs, perhaps from the disease generally known as cholera.

White.—Destructive diseases have prevailed among horses and swine in this county during the past year. About thirty head of horses have been lost. I estimate the value of hogs lost at $21,000.

CALIFORNIA.

Boulder County.—Cattle in this locality die, very often, of a disease called black leg. We have found no remedy for this disease. No other contagious disease prevails among farm animals.

Calaveras.—Horses in this county are affected by glanders and the epizooty. The diseases seem to be of a more fatal type than formerly. Sheep are affected with scab, and have to be doctored twice a year at quite a heavy expense and great loss in both numbers and value.

Contra Costa.—All classes of farm animals in this county are free from disease except hogs. Quinsy and pneumonia are the most common diseases among this class of animals. White hogs are also subject to a disease of the skin, which blisters and generally falls off on the head and along the back. Young pigs suffer very much from this disease, and are stunted in growth. Scab and the fluke-worm are common among sheep.

Lake.—Horses are suffering with gleet, or a similar disease, which seems to be the result of neglect while the animals were suffering with the epizooty. Rot is quite prevalent among sheep, of which we have between 45,000 and 50,000 in this county.

Merced.—Horses are affected with epizooty, and sheep with scab. The epizooty is of a mild type and but few sheep are lost by scab.

San Bernardino.—Colts here in the spring of the year are subject to distemper, but the disease rarely causes death. Sheep are pretty generally infected with scab, but the per cent. of losses is very small. Fowls are troubled with what is known here as swelled head. This disease is a very fatal one; we have no remedy for it.

San Diego.—The only losses sustained among horses are among those that are unbroken and run at large. When attacked by disease they cannot be handled, and usually die. The same may be said of cattle. The only disease that ever afflicts our sheep is the scab. A good many hogs have died, but of what disease I am not informed.

Ventura.—A good many lambs, at about the age of four months, are attacked with a peculiar and destructive disease, for which, as yet, we have discovered no remedy. The only decided symptom is that of great weakness across the kidneys.

Yuba.—Large numbers of chickens annually die in this county from a disease known as roupe.

COLORADO.

Lake County.—Infectious and contagious diseases have never yet occurred among horses and cattle in this county. The county contains a large number of horses and mules, and a limited number of cattte. The high altitude predisposes the former to lung complaints, and the latter suffer from lack of shelter during the long winters.

CONNECTICUT.

Litchfield County.—Tuberculosis, abortion, and fouls have prevailed among cattle to some extent. A few cows and oxen have died of the first-named disease, and many calves have been lost by the second, and the value of the cow greatly diminished thereby. By the third the use of oxen and the milk of cows are lost. While it is a disease widely prevalent, death rarely occurs.

New Haven.—The only disease of a contagious nature prevailing among any class of farm animals in this county is the epizooty among horses; no deaths have been reported.

DAKOTA TERRITORY.

Bon Homme County.—A few weeks ago cattle in the center of our county were afflicted with a disease which killed them generally within twenty-four hours. The first symptom was a lameness, followed by a swollen leg. The disease was supposed by some to be black leg.

Moody.—Many horses in this county are affected with a disease which causes a discharge from the nose. Many cases of farcy are also reported. Information as to the proper treatment of these diseases would be of great service.

Traill.—I have heard of two or three cases of glanders, and a few cases of lung fever in horses. Muscular rheumatism appears to prevail more extensively among these animals than any other disease. Fowls are often afflicted with scabby legs.

Yankton.—The epizooty is prevailing extensively among horses, but in a mild form. Black leg continues to carry off large numbers of cattle.

I estimate the value of our losses from this and other diseases at $3,000. Hogs are all afflicted with a disease that affects their hind legs. Fowls have the cholera.

DELAWARE.

New Castle County.—I estimate the value of the losses among farm animals in this county by disease for the current year as follows: Horses $3,375; cattle, $2,250; hogs, $1,800; sheep, $540; fowls, $7,500. Cholera among poultry has prevailed to a certain extent throughout the peninsula for fifteen years, and in many instances has destroyed the entire stock on a farm.

Susse.—Our losses among farm animals in this county by disease, during the past year will foot up about as follows: Horses, $3,750; cattle, $1,125; hogs, $2,500; sheep, $300; fowls, $7,500. The epizooty is prevailing in a mild form among horses.

FLORIDA.

Clay County.—As near as I can learn, the value of the farm animals lost in this county during the past year is about as follows: Horses, $168; cattle, $1,625; hogs, $6,000; fowls, $1,250.

Columbia.—Stock raised here is generally healthy, but it is quite the reverse with that brought from other States, except from South Georgia. A horse raised here, of the same general appearance as an imported one, commands from $30 to $40 more than the imported one.

Hamilton.—With reference to horses I would state that there are from 75 to 100 colts dropped in the county every year; but little over one-half this number are raised, as they die of staggers, generally during the first or second year of their age. No special disease prevails among cattle. About once in three years cholera prevails among hogs, and destroys them at the rate of 60 per cent. No contagious diseases seem to be prevailing among sheep and fowls.

Lafayette.—Horses here are affected with the epizooty and blind staggers. The former affection is very mild, but the latter kills almost every animal attacked. A disease called "salt" or sea sick kills at least 20 per cent. of the cattle bred here. Lime water seems to be the only remedy for this particular disease. Hogs are afflicted with many diseases thumps, heaves, vermin, &c. Every farmer has his remedy, but none are effective. A great many fowls are annually lost by cholera.

Manatee.—Horses in this county are affected with distemper, but as yet there have been no losses occasioned by it. Other classes of farm animals have been visited by no epidemic disease.

Putnam.—More horses die here of blind and sleepy staggers than of any other disease, though many die of colic, sand, and other causes. Many cattle died in the woods during the past season of diseases unknown to the farmers. I think the principal cause was the failure of the grass crop, which forced the cattle to eat poisonous plants and weeds. Alligators and wild beasts devoured some. These wild animals are the greatest enemies of the hogs. I learn that the two or three sheep owners in the flat woods lost nearly their entire flocks through the depredations of bears and panthers. Thousands of dollars' worth of hogs, cattle, sheep, and fowls are annually lost from depredations by alligators, bears, panthers, wild cats, coons, opossums, owls, hawks, rats, and other pests. I lost three out of four mules during the year. One of these died of the sand disease.

Santa Rosa.—The loss of hogs some years is very heavy in this county.

The disease seems to greatly vary. Sometimes during the fall of the year a very destructive disease visits our fowls. It is called wart-head. I do not know whether it is contagious or infectious or not.

Suwannee.—Cholera was quite prevalent among hogs in this county in the spring, and nearly all those attacked died. Other classes of animals have remained healthy.

GEORGIA.

Byron County.—As a general thing our farm animals are very healthy. There is some complaint of hog cholera, but it does not prevail to any great extent. Our stock depends principally upon the range for a living.

Camden.—About 100 head of cattle have been attacked by what is called here the putrid sore mouth. Swabbing the mouth with a solution of copperas seems to relieve the animals in a short time.

Catoosa.—During the year a strange lung disease broke out among our hogs, and has proved very fatal. We think we have found a remedy for it, however, in the following: We boil mountain ivy (this is poisonous to cattle in the raw or green state), and mix sufficient meal with it to make a good slop. This we give to the hogs repeatedly. They will recover under this treatment, shed off and thrive; at least this has been our experience.

Charlton.—Farm animals generally have remained in good health during the past season. Some hog and chicken cholera have prevailed, but these diseases have not been as general as formerly.

Clayton.—We have but few horses in this county, and they are free from contagious diseases. Cattle here have been healthy for some time past. Our hogs are frequently affected with a disease called cholera, but I think the affection is caused by the animal eating cotton seed.

Cobb.—Hogs and fowls suffer greatly with a disease known here as cholera. Large numbers of each die every year. Other classes of stock are free from disease.

Dawson.—Distemper among cattle and cholera among hogs and fowls prevails to a greater or less extent every year. We have no reliable preventive or remedy for these maladies.

Decatur.—It is thought that black tongue, a contagious disease which prevailed among cattle in this county in 1856, has again made its appearance among our herds. The losses among horses, swine, and fowls for the year have been quite heavy.

Dooly.—The most fatal contagious disease prevailing among any class of farm animals is that of cholera among hogs. Some years our losses are very heavy. Blind or sleepy staggers is the most prevalent and fatal disease to which our horses are subject. Sheep suffer to some extent from the disease known as rot, and cattle from pneumonia and sore tongue.

Fannin.—Our horses are now all afflicted with a mild form of epizooty. They have a cough and discharge from the nose. As yet it has not proved fatal in any case. Cattle are dying in the vicinity of Morgantown with bloody murrain. This disease seems to have been brought in from south of the Blue Ridge by infected cattle. A good many hogs have been lost by some sort of fever.

Fayette.—Horses that die here generally die of epizooty or distemper. A good many cattle are annually lost by murrain, and hogs and fowls by a disease commonly known as cholera.

Gilmer.—The epizooty has prevailed generally among horses in this county but has caused no deaths. Diseases among hogs and fowls have prevailed extensively and caused a good many deaths.

Habersham.—The prevalent diseases among farm animals here are murrain or cow distemper among cattle and cholera among hogs. Cholera also prevails among fowls. I know of no remedy for cow distemper or hog cholera.

Harris.—The only disease of an infectious or contagious character prevailing among any class of farm stock in this county is that generally known as cholera, which affects hogs and fowls. The disease does not prevail to any great extent this year.

Haralson.—Horses are affected with distemper, and some have died of blind staggers, caused by eating rotten corn and damaged fodder. Cows are quite often affected with hollow horn, which I think is caused by bad treatment. Hogs die of cholera, sheep of rot and the staggers, and fowls of a disease known as cholera.

Houston.—The losses caused by disease among our farm animals during the past year will reach from $12,000 to $15,000.

Jackson.—Some few cases of staggers have occurred among horses, and an occasional case of murrain and black tongue are reported among cattle. Hogs are very unhealthy; we lose a great many from fevers. Some call the disease cholera, while others pronounce it either lung or typhus fever. Cholera also kills thousands of chickens every year.

Jefferson.—The mortality among hogs has been greater than among any other class of farm animals in this county. Very few of these animals that are attacked ever recover. The effects of epizooty on horses that recover remain for years, leaving a lingering cough. I have an instance in one of my own animals.

Jones.—We have no very disastrous infectious or contagious diseases prevailing among our horses or cattle. The epizooty is raging among horses, but it prevails in a mild form, and I have heard of no deaths. A large proportion of our cattle die in March or early spring for want of proper attention. Hogs, sheep, and fowls have been subject to various infectious diseases, from which a large number have died.

Lumpkin.—Losses of farm animals in this county during the past year by disease have been very light—hardly worth mentioning.

Marion.—The epizooty, in a mild form, is prevailing among our horses. Hog cholera has prevailed to a limited extent in some localities. Poultry of all kinds suffer terribly from a disease known as chicken cholera. In my opinion the disease is brought on by improper treatment, both as regards care and feeding.

Milton.—I estimate the value of horses lost by disease in this county the past year at $1,000; cattle, $3,000; hogs, $2,400; sheep, $300.

Muscogee.—No special disease is reported as existing among farm animals in this county. Fowls of all kinds are afflicted with cholera, roup, and sore head, &c.

Newton.—Most of our farmers try to raise a sufficient number of hogs for their own use, but a large number have died during the summer from the ravages of a disease called cholera. They were generally sick a long time, and for this reason many persons were of the opinion that it was some other disease.

Pike.—We annually lose a great many horses in this county from staggers, colic, grubs, lung-fever, overwork, &c. I think these losses will amount annually to at least $15,000.

Pulaski.—I estimate the value of the losses of farm animals in this county for the year by the various diseases which afflict them, as follows: horses, $25,000; cattle, $2,500; hogs, $7,000; sheep, $2,500; fowls, $300. The principal loss among hogs is from cholera.

Quitman.—The only disease that proves destructive to our farm animals is swine plague. A similar disease is very fatal to fowls.

Scriven.—A good many of the horses in this county have been attacked by staggers during the past year. This is a very fatal malady. Cattle suffer with murrain, hogs with cholera, sheep with dry rot, and fowls with cholera. The losses among all classes of farm animals have been quite heavy during the past season.

Telfair.—The only disease that prevails as an epidemic among any class of farm animals is cholera among fowls, but I have no accurate figures as to losses.

Terrell.—The only contagious disease now affecting our horses is the epizooty. But few losses have as yet occurred. Horses are afflicted with a disease of the eyes, however, which has proved quite serious. About 5 per cent. of all our horses are affected, and 10 per cent. of those thus afflicted go blind.

Troup.—No epidemic or contagious diseases have prevailed among horses or mules during the year. Cattle occasionally die of Spanish or Texas fever, which seems to be a species of murrain. Almost every season fowls are afflicted with cholera and roup. The former disease is very fatal. Roup is generally fatal to young fowls.

Warren.—Contagious diseases seldom visit the horses and cattle of this county. Cholera prevails among our hogs almost every year, and we generally lose from one-fourth to one-half of our animals. I estimate the losses in this county for the past year at $20,000. Fowls are much troubled with lice, sore head, and cholera.

Wayne.—I estimate the value of the farm animals lost by disease in this county during the past year as follows: Horses, $2,500; cattle, $9,000; sheep, $600; and fowls, $120.

IDAHO TERRITORY.

Nez Percé County.—With the exception of glanders and a mild form of epizooty, I have no diseases to report as prevailing among horses. The former disease is rarely fatal, as the animals are killed to prevent the spreading of the malady. The only disease known among cattle is an affection of the hoof, caused by standing in muddy corrals. No remedy is of any benefit as long as the animal remains in the mud. Sheep suffer to some extent from scab.

ILLINOIS.

Adams County.—Hogs are now suffering from a disease generally known as cholera, but I do not think the malady is as fatal as in previous years. The epizooty has appeared in a mild form among horses.

Bond.—The only disease prevailing among horses is a mild form of epizootic distemper. Swine plague prevails to a considerable extent, but it is neither so wide-spread nor so fatal as in former years. Cholera among chickens has been unusually destructive.

Brown.—Among our hogs and poultry we have a great deal of so-called "cholera," that entails a loss of thousands of dollars annually. As yet no preventive or cure for this disease has been discovered. The more I become acquainted with swine plague in all its phases the more I dread and fear it, for it seems to be utterly incurable.

Carroll.—The only destructive contagious disease that has prevailed among any class of our farm animals during the year has been that of cholera among hogs. I think the value of our losses from this cause will reach $18,000. The disease is raging fearfully at this time, as is also cholera among chickens.

Clark.—Horses, cattle, and sheep have been comparatively healthy, but the losses among hogs and fowls have been very heavy. In 1878 the value of hogs lost was estimated at $2,102,784, to which should be added the loss of flesh and vitality of those that recovered, which was equal to one-half their value. The loss in 1879 was also very heavy, but this year perhaps $25,000 will cover the damage. We can scarcely hope to approximate the loss of fowls from what is called "chicken cholera." There is scarcely a farmer's wife who will not report the loss of from 50 to 200 head either this or last year. I estimate the loss at $112,500, but I do not think my figures will cover half the loss that the answers to my inquiries would indicate.

Clinton.—A few horses and a large number of cattle and hogs have died in this county during the past year of various diseases. Many cattle have died for want of proper care and attention. The value of the hogs lost will amount in the aggregate to between $16,000 and $18,000.

Edwards.—Horses in this county have been affected with distemper. A good many hogs have died with the disease still generally known as cholera.

Effingham.—This being a good mast year hogs are much healthier than usual. The epizooty prevails in a mild form among our horses.

Gallatin.—The epizooty among horses is prevailing generally throughout this county. A few losses occasionally occur among cattle. Hog cholera prevails to a greater or lesser extent every year, but I have no means of ascertaining the value of the losses.

Greene.—The epizootic is prevailing among our horses, and has caused some losses. But the worst diseases we have had to contend with have been Texas fever of cattle, swine plague, and chicken cholera. I cannot give the value of the losses from these diseases.

Grundy.—Farm animals in this county are comparativey healthy, and have been during the year. I think $5,000 will cover the losses for the current year.

Hancock.—The only contagious disease affecting farm animals in this county is the well-known disease of cholera among hogs, and a similar disease which proves most destructive to fowls. A gentleman who lost about one hundred head of hogs informs me that he opened a number of them, and found in the stomach, bowels, and thorax numbers of small maggot-like worms just large enough to be visible to the naked eye. While there has been some abatement of this disease, in certain localities it has been as destructive as usual. I estimate the value of our losses of swine from this cause during the year at $29,814, and of fowls by diseases incident to the feathered tribe at $37,500. Some losses have occurred among cattle from bloody murrain.

Henry.—I have no losses of consequence to record among farm animals in this county for the past season. A few hogs have been lost by the usual diseases, but the value of the losses will not reach $2,000.

Johnson.—Horses are now affected with influenza, but of a milder form than it was in 1872–'73. No losses by deaths have as yet occurred. Fowls are suffering from a disease known here as chicken cholera. Swine plague has prevailed to some extent.

Kankakee.—About one-half the horses in this county are at this time suffering from a mild form of epizooty. Diseases prevail among hogs, but not in an epidemic form. Losses occasionally occur from catarrh among sheep. Heavy losses annually occur from cholera among fowls.

Livingston.—The epizooty has made its appearance among our horses, but to what extent it will prevail and damage it will cause will have to be told hereafter. Cholera among hogs and fowls is the most perplexing and destructive disease we have to contend against.

McLean.—The epizooty afflicted almost every horse in this county during the past fall.. I heard of but few fatal cases. Texas fever among cattle prevailed three or four different times. Hog cholera has greatly decreased. The books sent out by your department have greatly benefited the farmers hereabouts in giving them information concerning the hog cholera.

Macoupin.—Our hogs and fowls have been less afflicted during the past season with the disease generally known as cholera than for some years past.

Montgomery.—A large number of fowls are raised, or attempted to be raised, in this county, but vast numbers of them die of a disease called cholera. So-called cholera or swine plague prevails to a limited extent in the county. The epizooty in a mild form is prevailing quite generally among horses.

Moulton.—No infectious or contagious disease has affected our horses, cattle, or sheep during the past year, but hogs and fowls have suffered from the disease commonly known as cholera for a long series of years—twenty years or more. I estimate the losses of hogs for the past year at $38,124, and of fowls at $4,236. Taking this estimate as a basis (and I believe it to be far below our losses in former years) the aggregate would be $762,480—equal to a tax of $3.50 per acre.

Ogle.—During the past year the losses of farm animals by disease have been small as compared to losses of former years. There has been quite a heavy loss among horses from various causes, but other classes of animals have not been visited by epidemics.

Piatt.—I estimate the loss of hogs in this county during the past year at 13,000 head. These, valued at $4 per head, make a loss of $52,000. They died of the disease commonly known as cholera.

Sangamon.—No infectious or contagious diseases have prevailed among farm animals in this county the past year, except so-called hog cholera to a limited extent, and the epizooty among horses the past month (November).

Shelby.—The principal diseases affecting our horses are acute founder and the distemper, or so-called epizooty. The former yields readily to a dose of aconite-root given in water, or by bleeding in the neck. Distemper is a form of sore throat and a swelling of the lower jaw so that the animal can neither eat nor drink. It usually terminates in an abscess, the suppuration of which can be hastened by warm poultices.. Appetite and recovery commence as soon as abscess breaks. Epizooty originates from a common cause. It is preceded by a slight cough, followed by sudden loss of appetite. The animal, with head bent nearly to the ground, looks jaded and rejects all food. The skin seems tight, like a drum; there is no disposition to move, and the animal stands moping all the time. Pine tar is used either in feed or by smoking. In six or seven days the appetite returns, and the animal gradually improves.

Stark.—Hog cholera has not prevailed near so extensively as in former years. The same can be said as regards the disease among fowls. Other classes of farm animals are in good health.

Stephenson.—Hogs have died in this county of the usual disease of hog cholera, or swine plague, at a fearful rate during the past year.

From the best estimate I can get I put down the losses of our farmers and stock-raisers for the year, in swine alone, at $69,120. I estimate the value of the losses among fowls at $2,550, and of horses at $680.

Vermillion.—All classes of farm stock in this county are unusually healthy for this season of the year. Cholera is reported as prevailing among hogs in some localities, but it is not of a very fatal character.

Wabash.—A disease known as cholera, or lung fever, prevails more or less every year among our hogs. It changes about from one neighborhood to another, and is generally most fatal to young animals. Fowls also suffer greatly with cholera.

White.—The only contagious disease affecting our horses is the common distemper. Hogs and fowls have suffered severely with the so-called cholera. I estimate the value of swine lost during the year at $20,000, and fowls at the same figures.

Will.—Cholera has prevailed to some extent among hogs in several localities in the county during the past season. The disease among fowls has been more general, and the losses consequently quite heavy.

INDIANA.

Adams County.—I have not heard of a single case of contagious disease among the farm animals of this county during the past two years.

Benton.—Several horses have recently died in this county of distemper. The disease is more malignant than I ever knew it before. Something like Texas fever has destroyed a good many calves. The disease has been confined to young animals brought here from the Chicago market. Large numbers of hogs and fowls continue to die of cholera. Sheep are occasionally afflicted with foot-rot and scab.

Brown.—The disease commonly called hog cholera has not prevailed for some time past in this county, except among pigs. A great many young animals, from one to three months old, have died of the disease, while the older ones have remained comparatively healthy.

Clay.—Epizooty prevails among horses in this county, but no deaths have been reported. Some three or four deaths have occurred among cattle from sore mouth and tongue. Hog cholera of a very fatal type prevails in some localities of the county. I have successfully used for three years, as a preventive for this disease, copperas (sulphate of iron). Dose, a tea-spoonful to a table-spoonful (apportioned to size of hog), every two to four days. I give it in solution or in bran mash.

Clinton.—A few horses have been lost during the past year by diseases incident to this class of animals. As usual, the losses among hogs by swine plague have been very heavy.

Decatur.—I estimate the losses of swine in this county during the past year at $25,000. The losses among other farm animals have been comparatively light. The loss among farm animals might be greatly lessened by proper care in breeding and subsequent treatment.

Hamilton.—The epizooty is at present prevailing extensively among horses in this county, but is not proving fatal. Hogs are still extensively and fatally affected with cholera. I think our losses for the past year will reach at least $20,000. The so-called chicken cholera is playing sad havoc among our fowls. It sweeps them clean wherever it goes.

Hancock.—The epizooty has prevailed among horses in this county during the past few weeks, but it has not been so severe as it was in 1872. A few deaths have occurred. Some cattle have died with a disease supposed to be murrain. Swine plague has not been so general or so fatal as during former seasons. The disease has been confined mostly to young pigs.

Howard.—An epidemic is prevailing among our horses, and has caused a few deaths. Cholera among hogs has prevailed with its usual virulence during the past season. I presume the losses caused by this disease will reach $24,000 for the year. Fowls are afflicted with chlolera.

Huntington.—Some hog cholera prevails here every year, but the losses have not been very heavy the past season. Perhaps 2 per cent. of the chickens have died of cholera.

Jay.—A few horses have been attacked by distemper, and I hear of some cattle that have been afflicted with a disease called black tongue. None died, however. Hogs are affected with cholera as usual. This disease is increasing at an alarming rate. I estimate our losses for the current year, by this disease alone, at $75,000. Chickens also suffer greatly with cholera.

Madison.—A disease prevails among horses in this county that is called "spasmodic colic" and which has been very fatal. The symptoms rather indicate inflammation of the stomach. It is said that no animal will survive a third attack. What is known as chicken cholera is quite prevalent.

Morgan.—The so-called cholera attacks annually about 50 per cent. of our hogs, and of those attacked about 80 per cent. die. The value of the losses some years will reach $100,000.

Orange.—Our horses have nearly all had the epizooty this fall, though very few have died. The only contagious disease that has prevailed among our cattle in recent years is Texas cattle disease. The last visitation of this disease was three years ago. Hogs are subject to cholera almost every year. Sheep and lambs had the scours (paper skin) very badly during the past summer. Many of them died.

Steuben.—The epizooty is prevailing as an epidemic among our horses, one in every three being afflicted. None have died, however. Hog cholera is spreading rapidly in this county. Some farmers have lost from five to fifty head. One man cut up his dead hogs for his live ones to eat, and finally lost all he had. The dead carcasses left he piled up in a heap on his place, where they are still lying and rotting.

Switzerland.—Cholera has prevailed among hogs to a limited extent, but the losses have not been very heavy. Cholera has been more destructive than usual to fowls during the past year. We have no preventive for this disease.

IOWA.

Adair County.—Cholera is the prevailing disease among hogs and fowls. Almost all that are attacked die. I estimate the losses of the former for the year at 20,000 head, valued at $40,000. Black leg frequently prevails among cattle.

Appanoose.—The loss of young hogs in this county has been very heavy. On my own farm, out of a herd of 200 head of young shoats, I lost 105 head, but stopped it by the use of the following remedy: 5 ounces of arsenic, 4 pounds sal soda, 2½ pounds sulphur, 1¼ pounds saltpeter. The above amount mixed with bran or meal slop, I used for *one* dose for one hundred head.

Audubon.—The only disease I have to report as prevailing among farm animals in this county is cholera among hogs. The disease is confined principally to young animals.

Buena Vista.—The epizooty prevails in a very mild form among our horses, but I have heard of no deaths. A large number of hogs have died of swine plague during the year.

Calhoun.—There have been some losses among cattle caused by black leg. Cholera has prevailed to a considerable extent among hogs with its usual fatality. Some sheep have died of foot rot, and a good many fowls have been lost, as usual, by the so-called chicken cholera.

Cherokee.—The only disease among cattle is black leg, and it is principally confined to calves. I hear of a few herds of hogs that are said to be affected with cholera.

Chickasaw.—Probably 75 per cent. of the horses in this county have been afflicted with the epizooty during the past season. In some localities in the county hogs have suffered from quinsy. Chicken cholera still prevails among our fowls.

Clarke.—A disease lately made its appearance among horses in this county somewhat similar to the old epizooty, but some call it influenza. About one-fifth of all the hogs attacked by disease die. Thousands of fowls die every year by cholera.

Crawford.—During the past year swine plague has caused a loss among the farmers of our county amounting to over $32,000.

Clay.—All classes of farm animals in this county are healthy with the exception of hogs. Occasionally a herd is afflicted with this disease and a few die.

Delaware.—The epizooty prevailed extensively during the fall and scarcely a horse in the county escaped. The prevailing disease among hogs and fowls is that generally known as cholera.

Des Moines.—Hog cholera has prevailed quite extensively in this county during the past year, and the losses have been very heavy. I estimate our losses at $100,000. Chickens annually die by the thousands of the disease known as cholera.

Fayette.—Diseases have prevailed to a limited extent among all classes of farm animals in this county during the past year. The largest losses have occurred among hogs.

Grundy.—I estimate the value of hogs lost by swine plague in this county during the year at $45,000. A good many horses and cattle have also died of diseases common to them.

Guthrie.—Distemper among colts is generally the worst trouble we have among our horses. Losses among cattle generally occur from black leg. So-called cholera occasionally prevails among hogs and chickens. Chickens attacked rarely recover.

Jackson.—The epizooty prevailing throughout the county among horses reached here the latter part of October, and is now prevailing generally in this county. The animals are now improving satisfactorily. No deaths have been reported.

Jasper.—The value of the hogs lost in this county by disease during the past year is estimated at $57,050. The disease which proves so fatal to these animals is termed cholera, though I think they are also afflicted with lung fever, diphtheria, and quinsy. I have found but little trouble in curing these diseases when taken in time. The great difficulty with most farmers is that they will not take the trouble to properly diagnose a case. There is no department of the farm so little understood as properly caring for and treating sick animals. As to losses among fowls, the most of the deaths are caused by a disease generally known as chicken cholera, though many die from diphtheria and roup. I estimate the value of fowls lost in the county at $27,000 for the year.

Kossuth.—The only contagious disease among farm animals in this county is the so-called cholera among hogs. Occasionally the black leg kills a few calves and yearlings.

Louisa.—I estimate the value of the hogs lost in this county during the year, by the disease known as cholera, at $15,000. The losses among other classes of stock have also been quite heavy, sufficient to make a grand total of losses for the year of from $18,000 to $20,000.

Marion.—The value of the horses, cattle, and hogs lost in this county by disease during the year will aggregate from $8,000 to $10,000.

Plymouth.—Cholera has prevailed among hogs as usual, and the losses have been a pretty heavy tax on the farmers. A very large proportion of the fowls in the county have also died of cholera.

Pocahontas.—No infectious or contagious diseases seem to be prevailing among horses, cattle, or sheep in this county. The loss of hogs by disease does not seem to affect seriously the business of raising them, but whole flocks of fowls are so liable to be lost by a disease commonly known as chicken cholera that it would be very unsafe to invest much capital in them.

Ringgold.—The principal disease prevailing among horses is distemper. An occasional case of lung fever occurs. Black leg, murrain, and mad itch have prevailed among cattle in some localities. While cholera has prevailed among hogs during the year, the disease has been of a milder and less fatal type than usual. Fowls die off at a fearful rate. There seems to be no cessation of disease among them, as they can be seen piled up in the fence corners the year round.

Shelby.—A kind of lung fever has been very destructive to young swine in this county during the past season. I estimate our losses at $6,000. Cholera among fowls has also been quite destructive.

Taylor.—I have heard of some cases of glanders in horses in some localities of this county. Cholera is the only disease existing among hogs. There is some scab in sheep, and many complaints of cholera among fowls.

Union.—Hog cholera has raged with terrible fatality during the past year. I think our losses among this class of animals during the year will reach, in value, the sum of $25,000. Horses, cattle, sheep, and fowls seem to be in better health than usual.

Washington.—There has been no contagious disease prevailing among farm animals in this county during the past season except cholera among hogs. This malady has not been so wide-spread as usual. The epizooty has prevailed quite extensively, but I have heard of no fatal cases.

KANSAS.

Brown County.—According to the assessor's returns there have been 296 horses lost by various causes during the year. The only contagious disease that has prevailed among these animals has been the distemper. About three months ago Spanish fever was brought into the county by some Arkansas cattle. Some 300 native cattle contracted the disease and died. Over 5,000 hogs were lost during the year, which were valued at upwards of $27,000.

Clarke.—We have had no Texas fever among our cattle since last year. We need stringent laws for our protection against this Texas cattle fever, as our losses are sometimes very heavy.

Cloud.—The only disease among cattle is the one commonly known as black leg. It is confined principally to calves and is quite fatal. Quinsy has prevailed to a considerable extent among hogs. The mortality is *principally* among pigs.

Crawford.—The epizooty has prevailed among horses in this county during the past season, and a few deaths have occurred. Some losses have been occasioned by cholera among hogs. The same can be said of fowls.

Davis.—A mild form of epizooty is now affecting the horses of this county. A few horses, cattle, and sheep die every year from disease and other causes. Some hogs occasionally die of cholera, but I do not consider the disease infectious.

Douglas.—A few cattle die annually of murrain and black leg. Cholera destroys a few hogs every year—but few, however, compared to the whole number. Some are killed by the hot sun when not well supplied with shade. Chicken cholera also prevails to some extent.

Franklin.—No infectious or contagious disease prevails among horses, except distemper among colts, of which a few die every year. The swine plague has not been so widespread among hogs in this county as in former years, yet I estimate the value of those lost by the disease during the past season at $18,000. Fowls die off rapidly with the cholera every year.

Hess.—Fowls have the cholera, and most of those attacked die. They are also afflicted with another disease, for which we have no name. They lose the entire use of their limbs and wings. They do not seem to be in any pain, and do not die of the disease, but being perfectly helpless they are generally killed.

Jackson.—One hundred and thirty-seven horses have been lost in this county during the year, one-third of which were affected with glanders and distemper. Out of 734 cattle lost, one-half died of black leg and ill treatment during the winter. A great many hogs and sheep have died, the former mostly of cholera and the latter from the effects of scab.

Kingman.—The epizooty has prevailed extensively among horses in this county and has proved fatal in many cases. A few cattle have died of black leg, and hogs of cholera. Sheep have been afflicted with the scab, but this disease seldom proves fatal. Large numbers of fowls die of cholera, a disease for which we have no remedy. About 20,000 sheep were brought into this county this fall.

Leavenworth.—I place our losses of swine for the year, by disease incident to them, at $15,000. I have no data as regards fowls; every three or four years the cholera sweeps them clean.

Lincoln.—A great many horses have died in this county from eating worm-eaten corn. Cattle have died from the ravages of a disease called black leg, though not a great many of them.

McPherson.—Horses in this county are frequently troubled with a skin disease, known here as Spanish or Texas itch. It only yields to persistent treatment. Cattle are troubled with black leg, a disease which is confined mostly to calves. A great many fowls die with the disease known as chicken cholera. Remedies do but little good.

Marion.—During the past year fowls of all kinds have died in great numbers, many farmers of our county losing all they had. All remedies appear to fail. From dissections made the liver seems to be the principal organ affected, as it is usually found twice its normal size.

Marshall.—We have lost some hogs in this county by the usual disease, but by far the heaviest losses we have sustained during the year have been among fowls. I estimate 200,000 fowls for the county. Of this number 50,000 have been afflicted and 40,000 have died. The value of these fowls I reckon at 15 cents a piece, which makes a total loss for the year of $6,000.

Meade.—Sheep in this county have what is called scab. None die of it. It can be kept in subjection, if not cured, by dipping in a solution of sulphur and tobacco, warm. The disease simply reduces the clip of wool, but does not endanger the life of the sheep. Nearly all our poultry become affected with sore heads and feet, and eventually get blind. About 10 per cent. die, and the remainder never fully recover. This disease seems to rage all the year round.

Mitchell.—During the past year swine plague has prevailed, as usual, among hogs, and large numbers of them have died. There has also been considerable disease among horses, cattle, sheep, and fowls.

Montgomery.—At least 50 per cent. of our horses and mules have been affected with a mild type of the epizooty. But few deaths have occurred. Cattle have suffered with black leg, murrain, and Texas fever. The latter disease proved very destructive.

Nemaha.—The only infectious or contagious disease prevailing among any class of farm animals in this county is black leg among cattle. Calves and yearlings are generally the victims.

Neosho.—The native cattle in some localities in this county were affected with Texas fever during the past season. Swine plague and chicken cholera have prevailed to a limited extent.

Osborne.—Our horses are afflicted with glanders, epizooty, and distemper, our cattle with black leg and murrain, hogs with cholera, and sheep with scab. Fowls are also diseased with cholera, a malady which proves very fatal.

Osage.—Horses have been affected with distemper, but I have heard of no losses. We have lost a good many calves by the disease known as black leg, and a few by red water. Scab is prevailing among sheep and cholera among fowls.

Ottawa.—Nearly every summer we have here a contagious disease among fowls called cholera. It proves very destructive some seasons. No contagious diseases exist among other classes of farm animals.

Pawnee.—Not many horses or hogs are raised here. It is a great sheep country. These animals are usually very healthy. Occasionally they are afflicted with scab, but this is easily checked by washing and dipping. Perhaps 10 per cent. of our fowls have died of cholera during the past year.

Russell.—Sheep are subject to scab and rot; the better grades escape this disease. Glanders is affecting some herds of horses; those not well cared for are generally the victims. Mules are more liable to the disease than horses. Cattle are affected with black leg and a species of distemper resembling the epizooty in horses. Fowls have suffered from cholera.

Saline.—A few cases of epizooty have occurred among horses. Chicken cholera prevails generally throughout the country. About all that are attacked by the disease die.

Smith.—Farm animals generally are in good health. Chicken cholera prevails quite extensively, and almost invariably proves fatal. We have no remedy.

Stafford.—Chickens are affected with the common disease known as cholera. I placed a little Spanish Brown in the watering trough which checked the disease among my fowls. Sheep are occasionally affected with the scab.

Wabaunsee.—Horses here are subject to distemper during the months of June and July. Cattle of all ages and grades suffer from black leg. We have no remedy, and about all die that are attacked.

Washington.—About one-twentieth of all the hogs in this county annually die of cholera, quinsy, or lung fever. About one-tenth of all other classes of farm animals die annually of contagious diseases. I estimate the value of all classes of farm animals lost by disease during the year at $18,925.

Wyandotte.—In addition to glanders, which is generally the most frequent contagious disease met with among our horses, these animals have just passed through the epizooty. A few died from the effects of the disease, but they were among those that were overworked.

KENTUCKY.

Allen County.—The epizooty is prevailing among our horses, but it is of a very mild type. A small number of these animals have died during the year of distemper and lung fever. In some localities of the county a good many hogs have been lost by the usual diseases. Sheep occasionally die of rot.

Ballard.—All kinds of farm animals in this county have remained unusually healthy during the year. Hogs and chickens have suffered to some extent with the diseases peculiar to them. A good many turkeys die from roup and other inexplicable causes.

Bourbon.—The epizooty prevails among our horses, but it rarely proves fatal. Cholera has carried off about 15,000 hogs during the year, entailing a loss upon our farmers of $60,000. A disease among lambs called white-skin has destroyed animals valued at $52,000. The blood of these animals seems to turn to water. We have no remedy for the disease. Chicken cholera is also very destructive.

Bracken.—About all the horses in the county are afflicted with distemper, but so far I have heard of no deaths. About one-half of our fowls annually die of a disease generally known as cholera.

Carroll.—The epizooty is prevailing in a mild form among our horses. Swine and chickens are troubled with what is called cholera. These diseases seem to yield to rational treatment, and there is less disease and less fatality where intelligent treatment is practiced in breeding and rearing.

Carter.—The epizooty is now prevailing among our horses as an epidemic, but yet in a mild form. Cholera also prevails to a considerable extent among our hogs and fowls.

Clay.—Hog and chicken cholera are about the only destructive diseases that have prevailed among our farm animals during the past year. The general condition of stock is about the same as last year.

Cumberland.—Some deaths have occurred among hogs, occasioned by cholera and thumps. Other classes of farm animals have remained healthy.

Edmonson.—We lose a good many horses in this county by distemper and blind staggers. Sheep are subject to disease of the feet. A great many hogs and fowls annually die of a disease known as cholera. I estimate the value of our losses for the year of swine alone at $7,000, and of poultry at $9,000. We ship eighty thousand dozen of chickens per annum from this station alone.

Fulton.—Horses, cattle, and sheep are healthy. Cholera annually prevails among hogs in some localities in this county. Some seasons the disease is much more destructive than others. The past season has been an exceptionally mild one, and I do not think the losses will exceed $12,000. A similar disease prevails among fowls, which annually causes heavy losses. I think the value of the fowls lost during the past year in this county by this destructive malady will reach $200,000.

Greenup.—A few horses have been lost during the year by sporadic diseases. The cholera has prevailed among hogs to a limited extent, but the losses from this cause will not aggregate over $2,000 or $3,000.

Harlem.—The epizooty has prevailed quite extensively among our horses during the past season, but I have heard of no deaths. The cholera has proved very destructive to hogs in some parts of the county. Other classes of farm animals have not been affected.

Knox.—Distemper is a common disease among horses in this county: glanders is of rare occurrence. Swine plague rages in some portions of the county at all seasons of the year. Cattle are sometimes affected with murrain, but never with pleuro-pneumonia. Sheep kept in low lands are often affected with rot.

Lincoln.—Our horses are suffering with the epizooty and distemper combined, which has proved fatal in a good many cases. Hogs die of cholera as usual. We have no remedy for this disease. Fowls are also subject to cholera, of which many die.

Lyons.—The only contagious disease prevalent among any class of farm animals in this county is that among hogs, which is generally known as cholera. Perhaps one out of every twenty of these animals annually dies of this disease.

McLean.—I estimate the value of swine lost in this county during the year by the disease known as cholera at $10,000. The only losses of any consequence have occurred among these animals, and among the feathered tribe by a similar disease.

Magoffin.—The epizooty prevails among our horses. Hogs and fowls are also suffering with cholera, but not to so great an extent as formerly.

Martin.—Cattle are affected with sore tongue and murrain. Hogs suffer more or less every year from cholera. Fowls are also afflicted with cholera. Sheep seldom die of disease.

Montgomery.—Some cholera prevails among hogs, and scab, foot-rot, and itch among sheep. The epizooty is affecting our horses, but it prevails in such a mild form that so far no deaths have occurred.

Muhlenberg.—The only disease of any consequence prevailing among horses is the epizooty, which has proved fatal in but few cases as yet. Cholera exists among hogs and fowls, and in most cases proves fatal.

Nelson.—The epizooty is raging among horses throughout the length and breadth of this county. Scarcely an animal has escaped. Hog cholera has been confined to a few localities, but it has been quite destructive in these.

Oldham.—With the exception of epizooty among horses, which is now prevailing here, no disease of any consequence has prevailed among farm animals during the past year. A few cases of swine plague have been reported, but the damage from this disease has been very slight.

Owen.—No disease has prevailed here for years among farm stock, except cholera among hogs and fowls. The disease usually proves very fatal.

Pendleton.—The epizooty is prevailing extensively among our horses, but as yet I have heard of no fatal cases. In some localities of the county hogs are dying in considerable numbers of cholera. The same can be said of fowls.

Todd.—There is scarcely a sheep in this county that is not affected with scab. The same can be said as regards distemper among horses. About all are more or less afflicted.

Trimble.—Our horses have got the epizooty, but as yet none have died. Hogs have been afflicted with cholera, but so far the losses have been comparatively light. Fowls always have more or less cholera among them—a disease which generally proves fatal.

Union.—Losses among farm animals have been quite a heavy tax to the farmers of this county the past year. The value of hogs lost I estimate at $20,000. A large number of horses, cattle, and sheep have also been lost by disease.

Wayne.—Lately our horses have been generally attacked with a mild form of epizooty. We have had very little cholera among our hogs this year; much less than usual. We have a new disease among cattle, but it is not very fatal. Fowls continue to die of cholera.

Woodford.—Almost all the horses in the county have been afflicted with the epizooty. The cholera has been so destructive among hogs during the past few years that the number annually raised has decreased about one-half. A great many young lambs died during the fall of an unknown disease. They became droopy, lost appetite, became greatly emaciated, and soon died. After death the skin was perfectly white, and the carcass seemed almost destitute of blood.

LOUISIANA.

Bienville County.—Occasionally we have horses die of bots, colic, blind staggers, &c. What few cattle we lose generally die of hollow-horn. Our heaviest losses are confined to hogs, of which numbers die every year. Fowls also die in large numbers.

Franklin.—The losses from diseases among farm animals during the past year have been comparatively light. The principal losses have occurred among horses and swine.

Grant.—Horses die here with bots and distemper, cattle with scours and bloody murrain, sheep with rot, and hogs and fowls with cholera.

Lincoln.—A great many horses have died during the past winter from blind staggers, a disease supposed to be induced by eating rotten corn. They die very suddenly.

Sabine.—A great many cattle die here during severe winters for want of proper food, care, and attention. Hogs are visited every spring and summer by a disease which is invariably termed cholera. I have identified three or four different diseases, or different symptoms, as manifested among animals in different parts of the county. The disease is always more fatal to fat than to lean hogs, and to young than to older ones. As to remedies, those that prove successful one year have no effect the next, and generally what will cure in one part of the county utterly fails in another. Sheep are afflicted to some extent with scab. About once in three years nearly all fowls die with the cholera.

Tangipahoa.—A very mild form of epizootic influenza is prevailing among horses in this county; no losses. Some losses have occurred among swine from hog cholera, and among sheep from scab, a small thread-like worm being found in the lungs and surroundings.

Union.—As to hogs, the average estimate of losses is 10 per cent. of all pigs before weaning time. Some trace the cause to hog cholera, which, in this county, covers every disease to which swine is subject. A good many cattle have been lost by the various diseases incident to them.

MAINE.

Androscoggin County.—The only disease prevailing among farm animals in this locality is epizooty among horses. The disease is very mild and no deaths have occurred.

Aroostook.—Horses are about the only class of farm animals among which losses have occurred during the past year. Sore throat prevailed among these animals last March and April to quite an alarming extent, and a small percentage of those attacked died. The epizooty is now prevailing. Nearly every horse has it, but in a mild form. No deaths.

Cumberland.—A large number of horses have been attacked with the epizooty during the past season. The disease has prevailed in rather a mild form, comparatively few cases having proved fatal. Cattle, hogs, sheep, and fowls are free from contagious diseases.

Sagadahoc.—Almost every horse in this county has been affected with what we call epizooty, but none of any value have died. A few sheep usually die late in the winter or in the early spring of worms in the head.

York.—The epizooty prevails in a mild form among our horses. Many turkeys and chickens have died of a disease we call roup.

MARYLAND.

Alleghany County.—I estimate the value of farm animals lost in this county by disease for the past year as follows: Horses, $15,000; hogs, $5,000; sheep, $2,000; fowls, $5,000.

Baltimore.—Thirty per cent. of our hogs have died during the past season from cholera. The epizooty is prevailing among our horses. No serious trouble is apprehended from this disease, as it prevails in a very mild form.

Calvert.—Last spring a disease attacked the horses of this immediate neighborhood, and eleven animals died. The disease seemed to be located in the brain, and the spine was affected. A disease is now prevailing among the same class of animals, accompanied with discharge from the nostrils, cough, and swelling of glands under the throat. A very destructive disease has prevailed for some years past among our poultry. We have no remedy.

Montgomery.—The health of farm animals in this county is generally good. As preventives are better than remedies, I think it all important that animals should have the advantage of exercse, air, good water, plenty of suitable food, and dry shelter to protect them from inclement weather. With these precautions a good and healthy stock may be easily kept in an improving condition and comparatively free from disease.

Worcester.—Some little epizooty prevails among horses, but the disease is of a very mild type. In a few localities some swine plague and chicken cholera prevails, but I am unable to give the aggregate losses occasioned by these maladies.

MASSACHUSETTS.

Berkshire County.—The epizooty broke out among horses in September, and, though of a mild form up to date, nearly every horse has had a touch of it. But few have been so bad as to prevent moderate labor where proper care has been used. The epizooty has probably become a disease to which the horse must hereafter be more or less subject, just as some diseases are among the human species—something like the horse distemper, which has been known for seventy years, or perhaps for a longer period.

Dukes.—The only disease I have to record among farm animals is one existing among sheep. The disease seems to be a worm in the head. Most of those attacked die. I know of no remedy.

MICHIGAN.

Barry County.—The epizooty is prevailing among the horses throughout this entire county, but it does not seem to be seriously affecting the animals. Some hog cholera is prevailing, but the disease is not so widespread as in some previous years.

Calhoun.—The only disease of any importance that has affected our farm animals was cholera among hogs. It broke out in two or three towns in the western part of the county, and was not checked until the farmers sold off their entire stock.

Cass.—With the exception of hogs, all classes of farm animals are free from disease. The so-called hog cholera assumes various forms in the same herd. It is usually most destructive to young pigs, but neither age nor condition are exempt.

Clinton.—Horses are affected with the epizooty, but the distemper seems to prevail in a mild form, as but few deaths have occurred. Cattle and hogs are measurably free from disease. In some localities sheep are affected with foot-rot.

Genesee.—The epizooty has seriously, and in many cases fatally, affected our horses. We have also sustained serious losses among sheep from infections and contagions.

Hillsdale.—During the warm weather of the past summer, hog cholera prevailed to a limited extent in the county. Recently the epizooty made its appearance among our horses, but so far it has prevailed in a very mild form.

Ingham.—I estimate the value of domesticated animals lost in this county during the past year, of the various diseases to which they are incident, as follows: Horses, $5,000; cattle, $264; hogs, $675; sheep, $2,880; fowls, $5,434.

Livingston.—Since the first appearance of the epizooty among horses some years ago, it makes its appearance here every year. There has been no exception. Foot-rot among sheep proves very fatal. I estimate the value of the losses in this county from this cause alone, for the past year, at $10,250.

Oakland.—A large proportion of the horses in this county are now affected by what is called the epizooty. But a small percentage of those attacked are dying, however. Hogs are suffering with a disease similar to that which afflicts those animals in the more southern States, and which is known as cholera. It rarely proves fatal except to small pigs.

Saint Clair.—No infectious or contagious disease has prevailed among farm stock in this county during the past year. The general condition of farm animals is about 15 per cent. above the average for previous years.

Wayne.—Influenza, or as, some call it, epizooty, has attacked a great many of our horses. They discharge at the nose, cough, but do not swell in the throat. With mild treatment and good care the animals soon recover. In Detroit some animals are reported as having dropped dead in the harness, showing that the disease is more severe in the cities than in the country. Some cases of hog cholera are reported.

MINNESOTA.

Aitken County.—Probably 30 head of horses have died in this county during the year, from all causes. Farm animals are generally healthy.

Anoka.—The only disease affecting horses in this county is the epizooty, of which a few animals have died. A large number of sheep are affected with an unknown disease. The first symptom is a cough resembling whooping cough, followed by discharge from the nose. Many animals become wholly blind; a thin blue skin covers the eye, from which they recover after a time. Very few have died.

Carver.—The only contagious disease is that of the epizooty, which is now prevailing quite generally among horses. The disease is quite mild, and so far no deaths have been occasioned by it.

Clay.—During the year lung fever has carried off about 15 head of our horses. Cattle have also died of a lung disease. When examined the side to which the lungs adhered had mortified. Black-leg has also carried off a good many cattle. The epizooty among horses has prevailed extensively in this county.

Freeborn.—Distemper among horses is the only contagious disease prevalent among farm animals in this county. Young animals are those most generally affected.

Isanti.—Cattle in this county are frequently afflicted with the disease known as black-leg. The disease is hard to check, and when it attacks an animal it generally proves fatal in a very few days. Another disease, commencing with drowsiness, followed by loss of appetite, frequently attacks and kills these animals.

Kennebec.—Between 200 and 300 horses in this county have been affected during the past year with epizooty. But one death has occurred. In the fall of the year cattle are affected with murrain. Upon opening them after death, and after the occurrence of the first frost, we find their stomachs full of oak leaves.

Martin.—Among horses we have a disease known as distemper, but so far but one animal has died from its effects. Cholera has made sad havoc among our hogs. Coal oil and carbolic acid are being used as preventives.

Morrison.—Horses are about the only farm animals in this county subject to contagious diseases. The diseases prevailing among these animals now are the epizooty and glanders, the latter disease to a very limited extent.

Nicollet.—Domesticated animals are comparatively free from contagious diseases in this climate, and their general condition, as compared with former years, is more favorable. As the county grows older, stock is given more care and better feed. Their improvement and increased value is quite noticeable.

Olmsted.—Horses have been affected with distemper and blind staggers. A number of hogs have died, but from what cause I am unable to state. Cholera and gapes have prevailed among fowls.

Pipe Stone.—A large number of horses in this county have been affected with glanders, nasal gleet, or catarrh; it is hard to determine which. I have treated several of them with success. I used sulphate of iron, pulverized to a powder, and gave a teaspoonful twice a day, also carbonate of iron, pulverized gentian, and quassia, each one ounce, mixed and divided into four powders, of which I gave two per day, in balls, and used injections of Radway's Relief in the nostrils, diluting the same with one-fifth of water.

Pope.—The epizooty prevails to some extent among horses, but seems to be spreading rapidly. Pneumonia has attacked a good many, and proved fatal in some cases. Murrain and black-leg have been quite prevalent among cattle of late years. One man four miles north of me lost seven head during the year by the disease.

Rice.—A mild form of epizooty is prevailing among our horses, but up to this time no deaths are reported. Some horses have died of lung fever. A few hogs have died of congestion.

Stearns.—Epizooty in a mild form is now prevailing extensively among the horses of this county. Distemper and glanders also occasionally appear among this class of animals. A few cases of black-leg have occurred among cattle. Hogs and sheep have continued in a very healthy condition.

Steele.—Four cases of glanders in horses have been reported in this county. I have heard of no losses among any class of farm animals from the effects of infectious or contagious diseases.

Stevens.—Within the past few days the epizooty has appeared among our horses. Rest and good care, with occasional bran mash, is about all the attention they require.

Winona.—A good many fowls die annually in this county from the effects of a disease called cholera. One gentleman lost 100 in four days. It is generally attributed to feeding whole corn, drinking foul water, &c.

Wright.—Nearly all of our horses are affected with the epizooty. With good care the malady is easily controlled.

MISSISSIPPI.

Attala County.—The general condition of farm animals in this county will compare favorably with previous years. But little attention is paid here to the raising of farm stock.

Calhoun.—Horses are rarely affected with anything but distemper. Cattle are occasionally lost by murrain. Hogs are afflicted with cholera, but not every year. Sheep are subjected to rot, but comparatively few die where any attention is paid them.

Choctaw.—Some few cases of cholera have occurred among hogs and fowls during the past season. Blue vitriol placed in slop for hogs and the drinking water for fowls is regarded as a good preventive of this disease.

Clarke.—Hog cholera seems to prevail at all seasons of the year in some portions of this county. I am reliably informed that black antimony, given in small doses, is a sure cure for the disease. I would therefore recommend it to those who have not tried it. So-called cholera has prevailed among fowls with its usual virulence; in some neighborhoods utterly destroying all fowls. No effectual remedy for this disease has been discovered.

Coahoma.—Before the levees were in part kept up our losses in horses, and especially mules, were enormous. Charbon, or animal erysipelas, was the most fatal disease. It is not prevalent now. Careless feeding and rough handling now kill more animals than all other causes.

Covington.—No contagious diseases are existing among either horses, cattle, or sheep in this locality. Hogs and fowls are dying off rapidly; hogs with a disease known as cholera and fowls with a similar malady.

Grenada.—Our stock has been unusually healthy during the past year, although we have had some hog and chicken cholera. We hope our good luck may continue, and that the farming community will pay more attention to this important branch of industry; for stock raising may be made very profitable if properly attended to and skillfully managed.

Greene.—A good many horses are annually lost in this county by blind staggers. But few diseases exists among the cattle, but a great many die every year from starvation and exposure. Hogs and chickens die in large numbers from various causes and numerous diseases. There have also been considerable losses among sheep, occasioned by sore-head and black-tongue.

Holmes.—A large number of farm animals have been lost by disease in this county during the past year. I estimate the value of the losses among the various classes as follows: Horses, $60,000; cattle, $1,200; hogs, $60,000; sheep, $500; chickens, $5,600. A large number of horses are imported into this county from Kentucky and Tennessee, and during epidemics of charbon about seven-eighths of those attacked die of bad treatment or neglect. Distempers, charbon, and cholera are the most destructive diseases we have to contend against.

Marshall.—I estimate the losses among our farm animals by disease, for the current year, as follows: Horses, $3,750; mules, $5,000; cattle, $640; hogs, $6,000; sheep, $200; fowls, $3,750. Sheep are fast growing in favor, and are destined in the near future to be greatly increased in numbers and improved in grades. We have excellent pasturage nearly all the year round.

Newton.—The principal losses of farm animals in this county are confined to hogs and fowls, if the latter may be classed as animals. The disease is generally known as cholera.

Panola.—Our horses scarcely ever die of any contagious disease except distemper. Still, many die of colic, blind staggers, bots, &c. Fully 15 per cent. of our cattle died last year of what I supposed was murrain. Hogs and fowls die in great numbers of cholera. The losses of all classes of animals for the year will aggregate from $8,000 to $10,000.

Tishomingo.—Hog cholera prevails here about once in five years. Chicken cholera is of more frequent occurence than any other contagious disease.

Tippah.—Horses in this county are affected with distemper, cattle with murrain, hogs and fowls with cholera, and sheep with rot. A good many of these animals have been lost by these diseases during the year.

Yalabusha.—Distemper and disease of the kidneys have proved fatal to a number of horses. The latter disease is not contagious, but generally proves fatal. Sheep are subject to rot. Fowls are afflicted with a disease similar to cholera in hogs, which frequently decimates whole flocks.

MISSOURI.

Adair County.—Distemper and epizooty prevail in a mild form among our horses. Hogs have suffered to but comparatively small extent this season. The prevailing disease is cholera. This malady is being more guarded against than formerly by cleanliness about the yards and pens and by the use of preventives.

Audrain.—The only contagious disease prevailing among our horses is distemper, or the so-called epizooty, which seldom terminates fatally. A few cases of black-leg have occurred among cattle. Swine plague prevails in some parts of the county nearly every year. In some cases whole herds of some sixty or eighty animals are carried away by it. From the best information I can get, the disease seems to be communicated by actual contact. Herds that are isolated are seldom if ever attacked. Among fowls the mortality is frequently great from cholera. Occasionally sheep are lost by grub in the head.

Barton.—The past season has been an unusually disastrous one to cattle in this county. They have died by the thousands of so-called Texas fever. There seems to be no remedy. Every man has one, but none seem to be of any benefit. Like the hog cholera in its destructiveness, it takes its course despite all treatment. I estimate the value of the losses caused among the farmers of the county by this dreadful pestilence at $50,000 for the year.

Bolinger.—Hogs are subject to many diseases, but every one that dies is believed to have died of cholera. Sheep are occasionally lost by grub in the head and by scab.

Cape Girardeau.—My knowledge of the general condition of the farm animals of the county warrants me in reporting entire immunity from infectious and contagious diseases, for so much of the current year as we have already passed.

Carter.—For the past year there has been no contagious disease among farm stock except that among hogs. The disease which prevailed among these animals two years ago was thought by some to be cholera, by others it was pronounced measles. The disease is the same this year, but it is of a much milder type.

Christian.—The usual disease has prevailed among hogs during the year, though the losses have not been so heavy as formerly. Cholera has prevailed among chickens, and at intervals scab among sheep.

Dallas.—A disease called distemper, which affects the nasal cavities and glands of the throat, and, in some cases, the entire animal, by swellings and ring sores, has raged among horses in this county during the last twelve months, and about 102 have died. The epizooty has prevailed, but in a very mild form. There have been some deaths caused among cattle by black-leg.

Douglas.—The only disease affecting horses is distemper, of which but few die. Black-leg has prevailed among cattle, from which some losses have occurred. Hogs are generally affected with cholera, from which many losses occur.

Franklin.—Disease is prevailing among fowls in this county, and the fatality is great. The epizooty is affecting our horses, but it seems to prevail in a very mild form. The ravages from swine plague have not been so great as in former years.

Gentry.—The only disease prevailing among farm animals in this county is the common one known as hog cholera. Chicken cholera also prevails, and is quite destructive to fowls.

Grundy.—The epizooty made its appearance among our horses in the early fall. It does not seem to have done much damage. Pneumonia has proved fatal to a good many hogs. The disease among fowls is known as cholera.

Hickory.—The only disease of a fatal character that has prevailed among any class of farm animals during the year has been that affecting cattle. Our loss in these animals will reach $5,000.

Jasper.—At least 2,500 cattle have died in this county during the past year of Spanish or Texas fever. Only about one-half of those affected died. I estimate the losses from this disease alone at $50,000. Swine plague has prevailed, but it has been mostly confined to young pigs and shoats.

Johnson.—I estimate that four per cent. of all the hogs in the county have died from swine plague during the year. This would make the total value of our losses among this class of animals about $5,000.

Livingston.—With the exception of a few cattle that came in contact with Texas cattle passing through the county, these animals have been entirely exempt from contagious diseases during the year. Our losses from this disease amounted to about $10,000. Hogs have been sorely afflicted with disease, entailing a loss upon our farmers of some $18,000 or $20,000. I am of the opinion that the indifferent treatment received by these animals, by allowing them to sleep in manure and straw, and their exposure to sudden changes of weather, are some of the chief causes of disease among them.

McDonald.—During the past year horses have been more or less afflicted with distemper. Cattle have suffered from murrain and Texas fever.

Mercer.—The loss of chickens by disease has been quite heavy the past year. With the exception of slight losses by scab among sheep, our losses in other classes of farm animals amount to but very little.

Miller.—Cattle, especially the younger animals, frequently die of black-leg. Hogs are afflicted with cholera, young pigs generally suffering more than older hogs. Fowls are also seriously affected with cholera.

Moniteau.—Quite a large number of hogs have died of cholera in this county during the year. I think the value of our losses will reach at least $4,000.

New Madrid.—My own hogs are now in a healthy condition, but I see a few dead ones every time I go a few miles from home. They die of cholera. Our horses have lately been visited by a mild form of epizooty, which so far has caused no deaths.

Nodaway.—I reckon the total value of all classes of farm animals lost in this county during the past year, by the various diseases to which they are subject, as follows: Horses, $6,000; cattle, $3,000; hogs, $15,000; sheep, $600; fowls, $750; total, $25,350.

Oregon.—A disease supposed to be murrain has seriously affected cattle in this locality during the past year. A good many hogs have been lost by the disease known as cholera, although the disease has prevailed in a milder form than in previous years.

Osage.—But few farm animals have been lost in this county by disease during the year. There has been some cholera among hogs and fowls, but the disease has not been so general nor so fatal as formerly.

Pemiscat.—Cholera has prevailed to a fearful extent among hogs in this county during the past year. All other classes of farm animals have remained in a healthy condition.

Perry.—Cholera has prevailed among hogs and fowls in this county to about the usual extent and fatality during the past season. Other classes of farm animals are in better health and condition than usual.

Phelps.—At this time the epizooty is prevailing to an alarming extent among the horses in this county. The only disease that ever seriously affects our sheep is scab, though but few die from this cause. Cholera prevails annually among our hogs, and in some years the mortality is very great. Cattle have murrain, and occasionally Texas fever, which is brought here from near the Arkansas line.

Platt.—The epizooty is prevailing among horses in this county. Some few have died, and many are unfit for use. The distemper has also been prevailing among young horses and cattle, and in some cases has proved fatal. Black-leg has also proved quite fatal to cattle in some localities. Cholera still proves very destructive to hogs and fowls. I estimate the value of the losses in this county of the former for the year at $50,000, and of the latter at $25,000.

Polk.—Cattle suffered in this county considerably during the past season from Spanish or Texas fever. Hogs have been remarkably healthy, but sheep have suffered from scab.

Pulaski.—The diseases which annually affect our horses and mules are colic, distemper, and blind staggers. Hog cholera is the name applied to every disease affecting swine. Quite a large number of hogs have been lost during the past season. An occasional case of black-leg occurs among calves or yearlings, which generally proves fatal.

Putnam.—This is a large stock-growing county, and hence diseases frequently prevail as disastrous epidemics among farm animals. I estimate the value of the losses among the various classes of domesticated animals by disease as follows for the past year: Horses, $30,000; cattle, $40,000; hogs, $600,000; sheep, $3,600; and fowls, $12,000. Total, $685,600.

Randolph.—The epizooty has prevailed in a mild form among horses in this county, but no deaths have occurred. The so-called cholera has been very fatal among hogs and chickens. Sheep are afflicted with scab, and occasionally cattle die of murrain.

Scotland.—The only disease we have had to contend against among our farm animals during the past year has been so-called cholera among hogs. I regard the disease as influenza or lung fever.

Schuyler.—Some cattle have died during the year with black-leg. We have lost some hogs by cholera, and sheep by scab and catarrh. Fowls die of cholera and from the effects of vermin.

Shannon.—Horses and hogs are the only farm animals in this county that are affected with disease, the former with distemper and the latter with cholera.

Shelby.—Hogs and chickens die off at a fearful rate in some localities of this county. The usual disease is known as cholera. Some persons lose at the rate of ten per cent., others as high as $\frac{2}{10}$, while still others will suffer no losses whatever.

Stone.—A large number of farm animals have been lost during the past year in this county by the various diseases incident to them. I estimate the value of these losses as follows: Horses, $8,000; cattle, $4,000; hogs, $1,600; sheep, $500; fowls, $100.

Sullivan.—The only infectious disease among horses is distemper, of which but few die. The worst disease among cattle, and about the only destructive one, is black-leg. It attacks thrifty young cattle, generally calves or yearlings, and an attack is equal to a death-warrant. The so-called cholera is very destructive to hogs and fowls. The value of losses among swine in this county for the past year from this disease will exceed $11,000.

Taney.—Distemper has been quite prevalent among horses in this county during the year, and in some cases it has proved fatal. A great many of our hogs annually die of cholera. Experience has taught us that wood ashes is a good preventive of this disease. In one pen I keep an ash-bank, and in another I do not. In the one in which I keep the ashes I have never had a hog die, while in the other I have frequently lost them by this malady.

Vernon.—I think the value of the losses among farm animals by disease during the past year will foot up about as follows: Horses, $1,750; cattle, $1,700; hogs, $11,100; sheep, $300; fowls, $5,400. Horses generally die of blind staggers; fully one-half of the losses among cattle were occasioned by Texas fever. Hogs and fowls are afflicted with but one disease, that commonly known as cholera. The only disease among sheep is that of scab.

Warren.—The only disease that has caused any serious loss among any class of farm animals is that of cholera among hogs. A similar disease has prevailed quite extensively among fowls.

Washington.—Those animals mostly affected by disease are generally those that are most neglected. Such is the case with swine and sheep, and the losses are generally greater among these animals than among other classes. Observation teaches me that where a farmer provides his stock with good pastures, clear water, plenty of good feed, and warm shelter in winter, his losses from disease will not exceed 1 per cent.

MONTANA TERRITORY.

Jefferson County.—A year ago, last summer and fall, one-third of our young stock calves—yearlings and two-year-olds—and a small per cent. of older animals died of black-leg. But very few died during the past season. As to the contagiousness of this disease stock-growers are very much divided in opinion. I am persuaded it is not contagious, although one-half my own young animals died of it. Cattle are free from other diseases. I do not think there is a veterinary surgeon in the Territory.

Lewis and Clarke.—The diseases prevailing among domesticated animals in this section are few and of a light character. The epizooty is now prevailing among horses. These animals are also occasionally afflicted with lung fever.

NEBRASKA.

Buffalo County.—Our fowls have been dying off rapidly with a disease called hen cholera. A good many sheep are annually lost by foot-rot and scab. This is regarded as a very healthy county for horses and hogs.

Cass.—Several horses and colts have been lost during the year by distemper. Out of a lot of 160 head of hogs I have lost, during the last 30 days, 67 of swine plague. The disease has somewhat subsided, and if does not break out afresh I will feel that I am more fortunate than my neighbors. I estimate the losses in this county for the year as follows: Horses, $4,000; cattle, $5,000; hogs, $50,000; fowls, $3,500.

Cedar.—A snow-storm which occurred on the 15th and 16th days of October caused the death of a larger number of domestic animals than were lost by disease during the remainder of the year. Some horses have been lost by lung fever, and a few cattle have died of black-leg.

Dakota.—Our horses are afflicted with epizooty. About fifty cattle, principally calves, have died of black-leg during the year. Cholera has prevailed extensively among hogs. Most of those that have died were young animals. Chicken cholera has destroyed a good many geese and ducks.

Esmeralda.—The only contagious disease affecting any class of farm animals in this county is a sort of distemper among horses. It prevails every season to a greater or less extent.

Fillmore.—About three-fourths of the horses in this county are suffering with a mild form of the epizooty. Some losses have occurred. Chicken cholera has prevailed to a considerable extent.

Franklin.—Cattle have been dying at a rapid rate in some localities of a disease called black-leg. This disease is supposed to be contagious, and is the only one of a contagious nature prevailing among any class of farm animals.

Greeley.—Our fowls are subject to some kind of contagious disease, from which large numbers die every year. Horses and cattle frequently die from neglect and ill treatment.

Harlan.—The past season has been an unusually unhealthy one for farm animals. Horses are now afflicted with a mild form of epizooty. Cattle have greatly suffered from black-leg, dry murrain, and Texas fever.

Jasper.—There is some black-leg prevailing among cattle, but the disease is not so widespread as in some years. Sheep are subject to scab and grub in the head, the latter always proving fatal.

Madison.—A considerable amount of epizooty is prevailing among horses in this county, and deaths are not infrequent from this cause. Chicken cholera prevails to a great extent as widely among those that run at large as among those that are confined in houses and yards.

Platte.—Horses in this county have been generally attacked by the epizooty, but in a much lighter form than when it appeared some years ago.

Polk.—The black-leg has killed a great many cattle in this county during the past year. We do not know what causes this disease, and have no remedy for it. A few horses have died of lung fever and glanders—not a great many with glanders. Hogs do not die of cholera, but for want of proper care, good breeding, &c.

Sarpy.—There is no disease among farm animals in this county except the usual one among hogs. This malady has not been so prevalent as usual this year, and has been mostly confined to late pigs.

Stanton.—Our horses are affected with the epizooty, cattle with black-leg, swine with cholera or swine plague, and sheep with scab. I estimate the loss of hogs for the year at between $6,000 and $7,000.

Webster.—The diseases among horses are confined to glanders, distemper, and Texas itch. Hog cholera prevails in some localities in the eastern part of the county. Large numbers of fowls annually die of cholera.

NEVADA.

Lander County.—There are no contagious diseases among our farm animals, but owing to long-continued drought 25 per cent. of our cattle died during the winter of 1879–'80 of poverty, and about 5 per cent. of our horses. About 12 per cent. of sheep died from a similar cause.

NEW HAMPSHIRE.

Cheshire County.—Our horses have had a general attack of a mild form of epizooty, but with good care nearly every case recovered within eight or ten days. Foot-rot has prevailed in some flocks of sheep, but it was easily subdued by proper treatment. Several flocks of fowls have been nearly destroyed by a species of cholera.

NEW JERSEY.

Atlantic County.—Horses suffered with a disease new, to this locality, last summer. The first symptom of the disease was similar to an attack of colic. This was soon followed by inflammation of the internal organs. Unless afforded immediate relief the disease terminated fatally. A veterinary surgeon here lost three cases out of nine. The epizooty is now prevailing among horses.

Hudson.—Out of 5,000 cows in this county 10 per cent. have been affected with pleuro-pneumonia. The State officers killed all those affected. The epizooty has prevailed to a considerable extent among horses.

Morris.—Horses are now suffering with a mild type of epizooty. Asafetida is a good remedy. So are sweet apples, given in as large quantities as the animal will consume. Fowls have suffered severly with cholera. When this disease breaks out it is very hard to overcome.

Middlesex.—The raising of fowls is one of the principal industries of this county. Of late years, however, the disease known as chicken cholera has seriously interfered with the success of this heretofore profitable business.

Salem.—No infectious or contagious disease is prevailing among any class of farm animals in this county. Fowls frequently die by the hundreds in some sections of the county. Hogs and poultry are extensively raised; indeed, poultry-raising is one of the most extensive enterprises of the county.

Somerset.—Horses in this county have been generally affected with influenza or epizooty this fall. Some few flocks of sheep have had hoof-ail. A number of fowls have died of cholera.. Farmers generally are taking better care of their stock than formerly, and it shows quickly in their improved condition and increased usefulness.

Warren.—A large number of chickens have died here during the past three months of a disease which appears more like pneumonia than cholera. Those attacked seldom get well. They mope and droop for about a week before death intervenes. One out of twelve of my own flock was all that recovered from the disease. I gave it a dose of castor oil and twelve grains of black pepper. I stopped the disease by administering large quantities of sulphur mixed with corn meal, giving every morning until it ceased.

NEW MEXICO.

Doña Aña County.—Distemper among horses and scab among sheep are about the only diseases prevailing among farm animals in this locality.

NEW YORK.

Broome County.—Horses at present are suffering with the epizooty. This affection has made its appearance with the autumn months for several years past. Deaths seldom occur from it, but our horses often get very weak and perform their duty with great respiratory difficulty.

Columbia.—From the best information I can gather I estimate the losses of farm animals in this county, from the various diseases incident to them, as follows, for the current year: Horses, $12,000; cattle, $3,000; hogs, $1,200; sheep, $1,200; fowls, $1,000.

Dutchess.—The only infectious disease prevalent among domesticated animals is the epizooty, which is now prevailing quite extensively among horses. I have heard of no fatal cases, however, as yet.

Franklin.—Last winter we had in this town a disease supposed to be swine plague. It did not spread to any great extent or last long. About fifty animals died. During the past three weeks nearly all the horses in the county have been afflicted with a mild type of epizooty. I have heard of but one death from the disease.

Fulton.—The epizooty is prevailing among horses, but in a much milder form than on its previous visit some years ago. Few fatal cases have been reported.

Genesee.—I estimate the losses of farm animals in this county for the past year, from the various diseases to which they are subject, as follows: Horses, $8,000; cattle, $2,500; hogs, $4,000; sheep, $4,000; fowls, $5,000. These estimates are based on my own observation assisted by returns of the census.

Madison.—The epizooty in a mild form has appeared among the horses of this county, but up to this time there have been but few fatal cases.

Ontario.—The number of horses affected with epizooty this fall will not fall far short of 75 per cent. of all the animals in the county. The disease has been very mild and but few have died.

Oswego.—During the past season some Texan cattle were pastured for a few weeks in this county. Afterward nearly every native cow of a large dairy, pastured on the same ground, died. An agent of the State made a thorough investigation of the matter, but the results have not yet been published.

Richmond.—The epizooty among horses is about the only contagious disease prevailing among any class of farm animals in this county. I can hear of no disease among fowls that could not be traced to local causes, viz., overcrowded yards and badly ventilated roosting places.

Rockland.—A large number of horses in this county are suffering with the epizooty. The disease prevails in a mild form, and as yet I have heard of no deaths from it.

Suffolk.—Some cases of glanders are reported, and a light form of distemper is prevailing generally among horses. Hogs are healthy, and I have to report but a small loss.

Wayne.—Horse distemper, or strangles, prevails more generally than all other ailments combined. The losses have been quite severe. Hogs are frequently attacked by an unknown disease, and soon die. Foot-rot is prevailing among sheep. The most fatal disease to fowls is the gapes. This disease is principally confined to young chickens.

NORTH CAROLINA.

Beaufort County.—It is a difficult matter to separate the value of those animals which die from contagious diseases and those which are lost by common and well-known maladies. I think $8,000 will cover the loss from all causes during the year.

Burke.—A good many cattle annually die in this county of murrain. Hogs, where kept in herds, are frequently attacked by cholera, and nearly all die. This disease seems to prevail in certain neighborhoods alternately.

Caldwell.—Except as to hogs the losses by disease among farm animals in this county during the past year have been very light. Cholera prevails among hogs to a considerable extent in some localities during the summer months.

Caswell.—Horses in this county have suffered with a mild form of epizooty during the past few months; in some localities of the county cattle are subject to a disease commonly known as distemper. About nine-tenths of those attacked die. A remedy for this disease would be a great benefit to the farmers. Large numbers of fowls die every year with a disease generally known as cholera.

Catawba.—Our farm animals have maintained very good health during the past year. Perhaps $5,000 will cover the losses occasioned by the various diseases to which they are subject.

Cherokee.—Quite a large number of hogs and sheep have been lost by the farmers of this county during the year by diseases common to these animals. The usual per cent. of other farm animals have been lost.

Clay.—About the only losses of farm stock in this county are the result of cholera among hogs and fowls. Milk sickness prevails at certain seasons of the year among cattle. This disease is quite fatal.

Columbus.—Our hogs and fowls have been afflicted with various diseases during the past year. But few seem to be similarly affected. Nothing like an epidemic, however, has prevailed among any class of domesticated animals.

Duplin.—The only contagious disease that ever afflicts our horses is an occasional case of glanders. Starvation kills more cattle than disease. All our energies are directed toward the raising of cotton, and no food is provided for them during the winter.

Gaston.—The most destructive disease we have to contend against among any class of our farm animals is that of cholera among hogs. Diseases among fowls also prevail quite extensively.

Greene.—So-called cholera among hogs has prevailed to a limited extent during the past season in this county. Chicken cholera has been more general and more destructive than usual.

Madison.—Disease prevails more or less extensively among our hogs every year. Other classes of farm animals have not been afflicted with disease during the year.

Nash.—Swine are the only domesticated animals in this county that have suffered with disease during the year. The losses have not been very heavy.

Pasquotank.—The only disease that has caused much loss among farm animals in this county during the past year has been cholera among hogs. This disease has been very destructive; in many instances nearly all the hogs on a plantation have died.

Robeson.—But few horses are raised in our county. They are used only for pleasure vehicles. Our supply comes from Kentucky, Tennessee, and Virginia through drovers. Our hauling and farm work is chiefly done by mules. Both horses and mules could be successfully raised here if our farmers would turn their attention to this business. When bred here these animals are more hardy and durable than those obtained elsewhere; they are not quite so large, but are healthier and last longer. Hogs are subject to what is known as cholera. The disease has not been so prevalent for the last two or three years as formerly. It was unknown here prior to 1861. Some attribute the prevalence of the disease to the introduction of the Berkshire and Chester Whites. We have no remedy or preventive for the disease, and nearly all that are attacked die. If they recover they are of no account, as they will not fatten. Cattle are free from contagious diseases. Sheep could be profitably raised here were it not for the worthless dogs. Fowls are subject to cholera and sore-head. Thousands annually die of these diseases. As in the case of hog cholera, we have neither preventives nor remedies.

Stanly.—A good many horses have been lost during the past season by distemper and blind staggers. The most prevalent disease among hogs is cholera. Almost all those that are attacked die. Chicken cholera is also very destructive.

Transylvania.—We have prevailing among our horses a disease generally known as distemper, but it seldom kills an animal. Cholera also prevails among hogs and fowls, but not so extensively as in former years.

Tyrrel.—As near as I can get at the figures I should say that about one-half the hogs in this county annually die of a disease generally known as cholera. In some localities the chickens die in heaps of a similar disease—a disease at least known by the same name.

Union.—We have lost a good many cattle and hogs by disease and neglect during the past year. I think the value of the former will reach $8,000, and the latter $10,000.

Warren.—Our farm animals are in better condition than usual. The hog crop is larger, owing to the heavy mast. We have some hog cholera, but it is not very general this season. I have examined some of the animals that died of the disease, but could find nothing wrong except the kidneys, and they invariably appeared much affected.

Yadkin.—Cholera still prevails to a limited extent among hogs in this county. I can give no estimate of the losses among fowls from a disease generally known by the same name.

Yancey.—The health of farm animals for the past year has been about an average one. Old sheep seem more liable to distemper than younger ones. Hogs and cattle have been afflicted with the diseases incidental to these classes of animals. Fowls are afflicted with the disease known as cholera.

OHIO.

Adams County.—Cholera and pneumonia have prevailed to a limited extent among hogs in this county; during the past year the losses have not been very heavy. There is complaint at present of the prevalence of chicken cholera in some localities.

Allen.—More horses have died during the summer of 1880 than ever before in the history of the county in any one year. A disease called by veterinary surgeons dropsy of the heart has proved very fatal, and many animals have died from it. There has also been much distemper (strangles) this season, and of a more virulent type than usual. Distemper can be cured, but dropsy of the heart has as yet met with no remedy, especially when it gets a firm hold on its victim. Sheep and cattle have been very healthy, and there has not been as much hog cholera as usual. Chicken cholera is a great pest, and we sincerely wish that a remedy or preventive could be found for it. It is generally fatal, and when it once gets into a flock it usually makes a clean sweep.

Ashland.—The only contagious diseases prevalent among farm animals in this county is the epizooty and colt distemper. Some losses have occurred from these diseases. A few cases of chicken cholera have been reported, but this disease has measurably disappeared during the past two years.

Brown.—The epizootic disease is now prevailing as an epidemic among the horses of this county. Nearly or quite all the horses are affected. The disease seems to be of a mild form, and as yet I have heard of no deaths.

Butler.—I estimate the value of hogs lost in this county during the year at $8,400. This is below the returns made by the assessors for the previous year. They have been less affected by disease the past season than for many previous years. Perhaps $1,000 would cover the losses among sheep.

Carroll.—The only really serious disease our horses have had to contend against is distemper. They are now universally suffering from a mild type of the epizooty. A great many are coughing and running at the nose, but the disease does not seem to be dangerous. There is some foot-rot and paper-skin among sheep, and cholera among fowls. When this latter disease attacks a flock it generally kills them all.

Clinton.—At least nine-tenths of the horses in this county are suffering from the epizootic. It is not dangerous except in cases where the animals are overworked, and then it almost sure to prove fatal. Sheep are considerably diseased with scab and foot-rot, both of which maladies are very contagious. The scab, while contagious, will originate on farms where there has been no disease of the kind before, seemingly from exposure. A very wet, warm winter will originate the affection, and when once started it proves very disastrous.

Fayette.—The losses among horses and hogs have been quite heavy during the past year. One firm in this town annually ships 100 tons of poultry and 3,000 barrels of eggs.

Franklin.—The epizooty recently made its appearance among horses in this county and is now prevailing extensively. The disease has made its appearance in so mild a form that I apprehend but little loss from it.

Geauga.—With the exception of a mild type of epizooty which is now prevailing among horses our farm animals are entirely free from infectious and contagious diseases.

Seneca.—Cases of hog cholera are occasionally reported, but there have been no serious outbreaks of the disease. Five per cent. will cover all losses among these animals. The epizooty, in a mild form, is prevailing among horses; no deaths. Perhaps 5 per cent. of our sheep are annually affected with foot-rot, but this disease is now pretty well understood and can be controlled.

Guernsey.—Farm animals in this county have continued in very good health during the year. Six or eight thousand dollars will cover all losses.

Lorain.—I give following estimate of the value of losses of farm animals in this county during the current year: Horses, $7,140; cattle, $8,222; hogs, $879; sheep, $2,264. I am not able to give an estimate of the number or value of fowls lost.

Lucas.—Our horses are just now affected with a very malignant form of epizooty. Hogs are also afflicted with fatal diseases in several neighborhoods of the county. Soft soap and ashes have been used with success as a remedy for this so-called cholera. Corn boiled in suds, with about one quart of soap to a bushel of corn, and also soap mixed with their drinking water, will be found beneficial.

Meigs.—The epizooty is now prevalent in a mild form. Scarcely a horse in the county has escaped, but as yet I have heard of no deaths In some localities the chicken cholera is quite prevalent and very destructive. Farm animals generally are in a healthy condition.

Monroe.—No contagious diseases have prevailed among any class of farm animals during the past few years. Chicken cholera, so-called, has been very fatal; in many cases whole flocks have died, not one escaping. We have no remedy for this destructive malady.

Montgomery.—But little stock is raised in this county. Our losses among swine during the year will perhaps reach $7,000, and among horses, $6,750. A few sheep and chickens have also been lost, but I hear of no loss of cattle.

Morgan.—A mild form of epizooty is prevailing among our horses. Early in the season the chickens were badly affected in some sections, but the disease subsided when the weather changed.

Morrow.—Many fowls die every year of a disease known as cholera. Among the hundreds of remedies the surest is that of prevention—that is, by cleanliness, keeping small lots, removal of offal, whitewashing coops, and a plentiful supply of gravel, charcoal, vegetables, copperas, and tar. Within the past few weeks the epizooty has broken out among horses in this county.

Ottawa.—The epizooty is now prevailing among horses, but is of a much lighter form than when it visited us some years ago. There seems to be no probability of serious loss.

Paulding.—Horses in this county are afflicted with the epizooty, but as it is prevailing in a very mild type, no deaths have been caused by it so far. Hog cholera thinned out the hogs this year fully 25 per cent. Fully 90 per cent. of those attacked die.

Preble.—Cholera prevails among both hogs and chickens. No other class of domesticated animals seems to be affected with contagious diseases, except it be horses, which are suffering from a mild type of epizooty. I estimate the value of hogs lost in the county by cholera at $10,000.

Trumbull.—The cattle in this county were recently attacked with Texas fever, a disease imported by Texas cattle passing among our native stock. Happily it broke out late in the season, and disappeared on the first appearance of frost. Perhaps 200 head died, quite 50 per cent. of those attacked.

Van Wert.—Horses are suffering with glanders and lung fever. Cattle have also suffered to some extent with lung fever. Cholera has prevailed during the season among both hogs and fowls.

Vinton.—The epizooty prevails among horses, but no deaths have occurred except among broken-down animals. Cholera is the only prevailing disease among hogs and fowls. Other classes of farm animals are in good health and condition.

Warren.—The disease called cholera has been unusually severe among our hogs during the past six months. I estimate our losses by this disease at $32,000. The value of cattle lost will probably reach $6,000, and of horses, $1,200. Perhaps $1,000 will cover the losses among fowls.

Wayne.—Influenza prevails quite extensively among our horses in the spring and fall. I hear of no diseases among hogs this season. A great many fowls are annually lost by the disease generally known as cholera.

Williams.—Horses have been afflicted with a mild form of epizooty. About 2 or 2½ per cent. of the sheep of the county have died during the past season, but no one has taken the trouble to try to discover the cause. Cholera has been quite destructive to fowls, so much so that on some farms whole flocks have been almost entirely decimated. On adjoining farms, where better care seems to have been observed in regard to disinfectants, the fowls have remained healthy.

Wyandot.—There has been some hog and chicken cholera prevalent in this county during the past season, but the losses have not been very heavy. The epizooty prevailed among horses for a short season in a mild form.

OREGON.

Benton County.—Farm animals in this county are remarkably free from disease with the exception of sheep. These animals are subject to scab, and occasionally to leech in the liver. Horses are frequently attacked by a mild form of distemper, but it rarely proves fatal.

Multnomah.—We have had no trouble with any class of farm animals in this county except hogs. They are affected with a disease we do not understand.

Polk.—Sheep in this locality are frequently affected with the scab, itch, and fluke in the liver. A few animals annually die of these diseases. Horses are sometimes afflicted with distemper.

PENNSYLVANIA.

Blair County.—The epizooty among horses has passed over this county. It prevailed in a mild form and did but little damage. A great many hogs are sick, and many have died. The disease seems to be the hog pest. The animal becomes dull, and after laying around a few days dies. Before death it becomes purple under the belly, throat, and about the ears—in fact the ears become purple first. Every remedy that could be thought of has been tried, but without effect. All my hogs died except one. This was affected like the rest, but I gave it some horse oil and to my surprise it commenced to improve and soon got well. It would be well enough for parties having hogs afflicted with the pest to try this remedy, as I am inclined to think it will prove effectual.

Bucks.—Three-fourths of the horses of this county are affected with the epizooty or are just recovering from it. Some have died and others have been left in a very weak condition. A few cows have died during the year of Texas fever and pleuro-pneumonia. Many sheep have suffered with foot-rot and scab, while in some sections of the county the chicken cholera has been very fatal.

Cambria.—Nearly all the horses in Johnstown and surrounding country are affected with a mild type of epizooty.

Chester.—The disease among fowls seems to be generally fatal, and frequently destroys whole roosts. The epizooty is prevailing in a mild form among our horses. Other classes of farm animals are healthy.

Elk.—Distemper among horses is about the only contagious disease ever known among farm animals in this county, and it is generally of a very mild type.

Fayette.—The epizooty has prevailed quite extensively among our horses—scarcely an animal has escaped. Some deaths have occurred, although the disease has appeared in a mild form.

Fulton.—The epizooty prevails among horses in this county, but it has appeared in such a mild form that no serious loss is apprehended. All classes of farm animals are in good health.

Juniata.—About all the horses in this county are more or less affected with the disease commonly known as epizooty. In different localities in the county cholera is reported as prevailing among swine.

Lancaster.—But few animals in this county are ever affected with disease. The epizooty is now prevailing among horses, but it has appeared in such a mild form that it is not regarded as dangerous.

Lawrence.—The epizooty has prevailed in a mild form among our horses. Some hogs have died of a disease called cholera, caused by being kept in filthy pens during hot weather. Fowls are subject to cholera.

Lebanon.—Chicken cholera is the only infectious or contagious disease prevailing in this county, and this could be avoided by cleanliness and better care of the fowls. There have been cases of distemper, and the epizooty is now prevailing among horses, but as yet there has been no material loss. There are losses from various causes which may carry away one animal in fifteen or twenty, at an average value of say, for horses $75 per head, or a total loss per annum of about $50,000; in cattle, probably about $20,000, and of hogs $10,000. Farm animals have good care and attention. Neither swine-plague nor pleuro-pneumonia have made their appearance in our county to my knowledge. Our State board of agriculture is doing a good work in this direction. Should we learn of a case of the latter disease we will at once inform the authorities and have it stamped out. Mr. Edge is a very efficient officer.

Lycoming.—The epizooty made its appearance among horses in this county a few days ago, and already the most of them are affected. To what extent it may prevail, or what amount of damage it may cause, remains to be seen.

Montour.—The epizooty has prevailed quite extensively among horses in this county during the first five or six weeks, and several old and worn-out horses have died from its effects. A great many fowls are annually lost by cholera. But few of those attacked recover.

Monroe.—A few horses and cattle have been lost during the past year by disorders common to these animals. Fowls seem to continue healthy as long as their houses are kept clean and well ventilated, but once the disease gets into a flock but very few escape death.

Pike.—Horses throughout the county have been affected by the disease called epizooty, and quite a number have died. The younger animals seemed to be much less affected by the disease than the older ones.

Somerset.—Farm stock generally, in this county, is very healthy. Large numbers of fowls annually die of the disease commonly known as chicken cholera.

Sullivan.—Horses throughout the county have a mild form of the epizooty. Cattle have been subject to foul in the foot—more so than for many seasons past. Sheep have foul in the foot, scab, and grub in the head.

Venango.—At present the epizooty is raging among the horses in this county, which accounts for the large number marked "infected." I can learn of no infectious diseases prevailing among cattle, hogs, sheep, or fowls. Of course a considerable proportion of each die every year, but not of infectious diseases.

Washington.—The influenza, or so-called epizooty, among horses is general, but in a much milder form than in 1872. But few fatal cases so far. Fowls are affected at all seasons of the year. Foot-rot is becoming an almost general malady among sheep, and is very troublesome and injurious. A great many sheep are annually lost by grub in the head.

Wayne.—The epizooty is prevailing quite extensively among horses in this county, but in a mild form, and up to this time but few deaths have occurred. Cattle are not in good condition, owing to drought and consequent lack of pasture.

York.—The epizooty is at present prevailing quite extensively among horses, but it seems to be a rather mild form of the malady, and yields readily to kindness and proper care and treatment.

SOUTH CAROLINA.

Clarendon County.—Large numbers of fowls die every year in this county of the disease generally known as cholera. We have no remedy or preventive for the disease.

Fairfield.—Colt distemper sometimes proves very troublesome here. During some seasons our hogs are attacked by a disease called cholera, which generally proves very destructive.

Horry.—We have no unusual diseases among our farm animals except cholera among hogs, and, I think, this malady is becoming gradually less general and fatal.

Kershaw.—The epizooty has prevailed in a mild form among horses in this county during the past season. Cattle are healthy. Hogs suffer a great deal from a disease called cholera, and the loss in some years has been so great as to seriously interfere with breeding them. Chickens are also subject to cholera, and sometimes the losses are very heavy. Everything has been tried either as remedies or preventives with varying success.

Oconee.—Fowls suffer periodically, say once a year, from a disease assuming various forms, but which is usually termed cholera. This disease, in fact but very few diseases were known among chickens in this county until after the introduction of foreign breeds. We have a disease among cattle in the mountainous parts of this county—in northwestern Georgia and western North Carolina, in fact along the whole Blue Ridge range—known with us as milk sickness, which is caused by a peculi poison taken by cattle with their food. It affects the beef, the milk, a the butter, and in turn poisons those who partake of either.

TENNESSEE.

Anderson County.—Influenza in a mild form in horses has reached th county, but by proper treatment it is easily arrested and cured. H cholera, so called, prevails constantly to a greater or less extent in th county. Where preventives are used, such as an occasional dose of su phate of iron and flowers of sulphur, and proper cleanliness observe the disease does but little damage. Sheep are subject to scab, foot ro and grub in the head. Proper attention to their sanitary condition wi obviate most, if not all, these evils. An occasional change of pastu and a dose of flowers of sulphur, together with an efficient wash to fr them from ticks, will do much to contribute to their growth and pro perity. Chicken cholera interferes materially with the successful grow of poultry. By due precaution I think it may be prevented, *i. e.*, b keeping the body free from vermin and internally healthy by a judicio use of copperas and sulphur.

Bedford.—The only contagious disease here to which horses are subje is distemper, and the only one affecting hogs and fowls is the so-call cholera. The losses among these three classes of animals have be quite heavy.

Bradley.—Farm animals in this county are in very good health a condition. An occasional outbreak of hog cholera is reported, but t losses for the past year have been light.

Claiborne.—In two localities in the county swine plague has prevail during the past season, but not in as fatal a form as usual. Our hors and mules are now affected with the epizooty in a very mild form. Th have a cough and discharge at the nose. Two or three doses of powder sulphur stops the cough.

Dickens.—Horses are suffering from a mild form of epizooty. No deat have as yet been occasioned by the disease. A number of hogs ha died of cholera. Farm stock seems to be in a better condition th usual.

Dyer.—Infections and contagious diseases of animals in this county a confined almost exclusively to hogs and chickens, and is known as choler No particular changes in the character of the disease have been observ since it first made its appearance, and no specific treatment has be established from the fact that the disease runs its course despite the u of all supposed remedies. It comes, and goes, and kills, and that about all we know about it. We now have a very mild form of epizoo among our horses, but it does not interfere with the services of t animals.

Fentress.—The only disease that has prevailed among horses duri the year has been distemper. Hogs have suffered in some localities fro the cholera and a good many losses are reported. In the localities i which the cholera prevails among hogs the same disease is seriously affec ing the fowls.

Greene.—Our principal losses are among hogs and fowls. Swine gro ing seems to be on the decline, as does also the disease of cholera. Thi perhaps, is owing somewhat to the diminished number of animals. The seems to be an increased attention paid to the raising of fowls, althoug chicken cholera at intervals is formidable and without remedy.

Hamblin.—Cholera has prevailed among hogs and fowls during th past year with the usual virulence and fatality. I have made it a rule to change my cocks every year, and have no trouble with cholera among my fowls.

Hardin.—During dry seasons the cattle of this section are seriously affected with a disease known as dry murrain. A good many animals were lost by it last season. Chickens are afflicted with cholera, a disease which proves very fatal.

Henderson.—Hog cholera has prevailed in some localities in this county during the year. Cattle have been affected with a disease which causes swelling of the eyes from which water runs freely. Some animals have become totally blind, but they generally recover after a lapse of six or eight weeks. Blind staggers has prevailed among horses, and foot rot among sheep.

Lake.—Considerable losses have occurred among hogs in this county during the past year, caused by the disease generally known as cholera. They will aggregate $6,000.

Lawrence.—The only infectious or contagious disease that has visited horses in this county was glanders. It was confined to one farm, and in each case proved fatal. Preventive measures were used to stop the spread of the disease. Hog cholera made its appearance on water courses in August, and about one-half of those attacked died. There is no record of this disease occuring on the table land away from the water courses. The elevation of the table lands of the county is 400 or 500 feet above the creek valley, and it is worthy of investigation to determine the fact of the susceptibility of the hog to the influence of damp malarial districts, and the liability of stagnant water to produce the malady. The table lands of this county are dry, and the only water hogs can obtain in the summer months is pure spring water. Chickens are frequently attacked by a disease miscalled cholera. In most cases it proves fatal. We have neither remedy nor preventive for this disease.

McVairy.—For several years past the cattle of our county have suffered severely with murrain. Hog cholera prevails to a greater or less extent every year. A disease of the same name annually destroys large numbers of fowls.

Meigs.—Horses and cattle are measurably exempt from contagious diseases. Hogs do not suffer every year with the plague—at least the disease is not always of a fatal type. This year the farmers of the county have suffered a loss reaching as high as many thousand dollars. Every year our fowls suffer with the disease known as chicken cholera, and a great many of them die.

Putnam.—Distemper, blind staggers, and lung fever have caused the death of some horses in this county during the year. Cholera among hogs has prevailed with its usual destructive effects. Sheep are healthy, and no disease is reported as prevailing among cattle. Large numbers of fowls have died in the course of the year of the disease commonly known as cholera.

Robertson.—I do not hear of the prevalence of any epidemic among farm animals in this county, except among hogs. The disease affecting them is the so-called cholera, and seems to be more general, and more destructive among those kept at large distilleries. When the disease breaks out in a herd the sick are generally separated from the well ones, and tonics and alteratives given the well animals to keep them in good health. However, when the disease gets a good start among a herd nearly all die.

Sullivan.—At this time there is a considerable amount of distemper prevailing among farm animals in this county. But few losses have occurred.

TEXAS.

Anderson County.—The only contagious disease prevalent among horses is distemper. Animals are never affected a second time by this disease. Cholera among hogs generally proves fatal. Many of these animals are annually lost for want of common sense in their treatment. Salt and wood ashes are doubtless a preventive if not a specific. Cholera prevails among fowls. No reliable remedy is known here for this disease.

Austin.—Last summer and fall distemper prevailed among our horses to an alarming extent, resulting in the death of many animals. Murrain, which by some is considered contagious, has caused heavy losses among cattle. The disease always attacks the best and fattest animals. There are heavy losses among hogs every year. This has been particularly the case during the current year. Cholera and chicken pox have destroyed a great many fowls.

Bee.—Diseases have prevailed during the past year among horses, swine, and sheep. I think the value of our losses among these three classes of animals will reach somewhere between $12,000 and $15,000.

Bell.—The disease known as scab prevails in many flocks of sheep, and has caused considerable loss among these animals. Two dippings of the diseased animals in strong tobacco water, about two days apart, will generally effect a cure. Cholera is very fatal to fowls on many farms. Clean roosting places and a liberal use of sulphur about nests, and carbolic acid about their perches and houses, will prevent the appearance of this disease.

Brazos.—Horses, cattle, and sheep are generally healthy. Hogs and chickens are subject to cholera. About all those attacked by this disease die.

Burleson.—Horses have suffered from distemper and the epizooty during the past year. Black tongue has prevailed among cattle, cholera among swine, and rot among sheep. A great many of our fowls annually die of the disease known as chicken cholera.

Chambers.—The only serious diseases we have to contend with among our horses and cattle are cholera, which affects both horses and cattle, and a disease which we call murrain, which is incident to cattle only. Sheep and hogs are generally healthy. Cholera among fowls is very destructive to the feathered tribe.

Coleman.—The only class of farm animals in this county seriously affected with contagious disease is horses. The disease is a distemper, and by some of my neighbors is thought to be glanders, while some others regard it as farcy. All die that take the disease.

Collin.—Except an occasional case of colt distemper, which generally yields readily to proper treatment, and blind staggers, I have no other diseases to report as prevailing among farm stock in this county.

Comal.—The principal disease that has prevailed among horses in this locality during the past season has been distemper. Some losses have occurred. Cattle are affected with a disease of the kidneys. Calves under one year of age, and generally those in best condition, are most frequently affected with it. Hogs estimated at $5,000 in value have been lost during the year by the usual diseases.

Comanche.—Recently I have heard of a few deaths among horses occasioned by a disease called blind staggers. Occasionally I hear of great mortality among fowls, but I can give no estimate of the losses.

Coryell.—No infectious or contagious diseases prevail among horses or cattle in this county, yet a good many of these animals annually die for want of proper care and attention. Hogs and fowls are affected with cholera, and few that are attacked recover. All classes of farm animals need more attention and better protection from the inclemency of the weather.

Dallas.—Horses are dying here in great numbers from a disease known as blind staggers. The disease has recently made its appearance here, and is thought to be caused from eating rotten and worm-eaten corn. We had fine rains and an abundant yield of corn, which bred an unusual number of worms, the effects of which are now seen in the large amount of dust in the dry corn. Cattle die mainly of bloody murrain. Sometimes we lose half our crop of chickens by cholera.

Ellis.—A good many horses have recently been lost in this county by blind staggers. The losses have occurred generally among good work-horses.

Gibson.—Epizootic distemper has prevailed among our horses to a considerable extent during the past year. Cholera has also prevailed among hogs in some localities. New milk with wheat bran, and a small portion of coal oil, mixed, has been used with some success in this disease. Gapes and cholera prevail among fowls.

Grayson.—During the past year the losses among hogs and fowls have been very heavy. I estimate the value of hogs lost at $15,000, and fowls at $3,000. The disease is known here as cholera, and has prevailed in this county for ten or fifteen years past. If it were not for the ravages of this disease poultry would be a great source of profit to the farmers of the county.

Grimes.—Glanders has prevailed among horses in one locality in this county during the past year. A great many cattle died from poverty last winter. Swine plague raged throughout the county during the winter and spring of 1877–'78, and killed nearly all the hogs. It finally subsided, and has not prevailed since.

Hamilton.—Distemper is the principal disease affecting horses. It is quite fatal to colts and yearlings. A disease for which we have no name is quite prevalent among sucking calves. It seems to be more fatal to fine graded stock than to the common breed. The first symptom is a watering of the eyes; after two or three days the eyes become very much inflamed, and a couple of days later it becomes apparently blind and refuses to eat. Those that remain in this condition generally die at the end of six or seven days.

Harrison.—With the exception of cholera among fowls there seems to be no infectious or contagious disease existing among farm animals in this county.

Kendall.—Farm animals generally in this county are in a healthy condition. Scab and foot rot have prevailed among sheep to some extent, and cholera among fowls.

Llano.—During the past few years our hogs have been subject to the disease generally known as cholera. Since it made its appearance our losses have been annually about one-fifth of all our animals.

Morris.—The only serious disease we have to contend against among our horses is blind or sleepy staggers. About all die that are attacked. Cholera prevails among both hogs and fowls. This disease proves very fatal, especially to chickens. We have neither a preventive nor remedy for the disease.

Navarro.—I know of no contagious disease prevailing among any class of farm animals, except cholera among hogs. I suppose there is an annual loss of 10 per cent. of these animals from this disease alone. Fowls are also annually afflicted with the disease commonly known as chicken cholera. Horses are subject to distemper, which rarely proves fatal. Cattle are frequently attacked by bloody murrain, but I do not regard this as an infectious or contagious disease.

Rains.—Horses are dying at an alarming rate all over this State of a disease generally known as blind staggers.

Rusk.—More sheep died the past summer from disease than have died in any one year for the past fifteen. Those that are afflicted refuse to follow the flock; stand around in the fence corners a day or two and then die. Not knowing the cause of the trouble we can do nothing for them. I lost a pair of Cotswolds which I imported from Wisconsin at considerable expense. Much disease prevails among chickens and turkeys in this county.

Victoria.—Some cattle-raisers of this county lost the past summer about one-fifteenth of all their calves by a disease affecting the hip. It commenced with lameness and ended by swelling above the knee, followed by a profuse purulent discharge.

Waller.—The loss of hogs in this county last spring from a scarcity of corn was very great. Horses and cattle have been free from disease. Sheep, however, have suffered terribly. The under jaw of the afflicted animal would become greatly swollen, it would refuse to eat, and soon die. Others would droop for a few days and then die. Some persons attributed it to a poisonous weed which is most prolific in wet seasons.

UTAH.

Box Elder County.—I estimate the losses among horses, cattle, sheep, and fowls in this county during the past year at about $7,000. No unusual or destructive disease has occurred among any class of domesticated animals.

Morgan.—Sheep in this county are subject to scab, and lambs to pneumonia. Other classes of farm animals are healthy. Winters here are very hard on fowls, and in the fall they are much subject to disease.

Tooele.—The diseases most prevalent among farm animals in this county are epizooty among horses, black death or black-leg among cattle, and scab among sheep. Our annual losses from these diseases will amount to $3,000 or $4,000 in value.

VERMONT.

Addison County.—Epizooty in a mild form is quite prevalent among our horses. Sheep are to some extent liable to foot-rot. Breeders generally agree, however, that this disease does not lessen the value of the animal, as it is well known and easily cured.

Grand Isle.—The epizooty has been very general among horses this fall, but in nearly every case it has appeared in a light form, and there have been but few deaths.

Orleans.—Our horses have been afflicted with the epizooty, which is said to be infectious and contagious. A few good calves died suddenly with swelled head and a sore throat—an unknown disease here. Several flocks of sheep are afflicted with the scab, from which several animals died during last winter. It has not been easily cured.

Washington.—With the exception of occasional cases of scab among sheep, we have no contagious diseases among farm animals. Our farmers and breeders are giving more attention to the care of animals than formerly, and as a result we have less exposure, less disease, and a better condition of all kinds of domesticated animals. Proper care in the breeding, rearing, and treatment of farm animals will pay. Improved systems are so well understood that it does not seem necessary to advance any theory as to methods.

VIRGINIA.

Amelia County.—The disease usually termed cholera is almost always fatal to hogs. There has been a serious affection among our sheep, which has caused the loss of a good many of these animals. Upon *post-mortem* examination we invariably find the lining membranes of the nostrils greatly injected with dark-colored bloody mucus, and a large grub which has made its way up the nostril as far as possible.

Botetourt.—Black-leg and bloody murrain have proved quite destructive to cattle during the past year. Cholera has prevailed among hogs and fowls with its usual fatality.

Caroline.—All classes of animals in this county have this year been unusually free from infectious and contagious diseases, except horses and mules. These animals have been afflicted with the epizooty, but where proper care has been observed no serious results have followed.

Carroll.—The epizooty and distemper prevails among our horses, and some deaths have occurred. Hundreds of fowls have been lost by the gapes.

Charlotte.—Horses are afflicted annually with distemper, and about once in five years by epizooty. These diseases are not very fatal. We annually have a few cases of glanders and farcy, which are always fatal. Cattle are subject to the North Carolina distemper, which is generally fatal. The disease resembles the Texas fever, and usually first attacks the fattest animals. Hogs suffer more or less every year with the disease known as cholera. The principal disease among sheep is grub in the head. Fowls are afflicted with cholera, a disease which generally terminates fatally, as we have no remedy.

Chesterfield.—Some losses have occurred from the epizooty among our horses. Cattle are generally healthy, but a few have died of bloody murrian. Cholera has prevailed to a less extent than usual among hogs, and our losses have been light the past season. Immense losses continue to occur among fowls, from the disease generally known as cholera.

Clarke.—The only contagious disease that ever prevails among any class of farm animals in this county is swine plague. We have had none of it this year. Poultry plague, or cholera, prevails every year, and causes heavy losses annually. We have no cure or preventive for the disease.

Craig.—Cattle in this section of the State are subject to a strange disease which has not been described in any work on the diseases of domesticated animals. I will try and give you the symptoms of the malady in a future letter. About one-half of our chickens annually die of disease.

Dinwiddie.—Nearly all the horses in this county have had the distemper and epizooty this year. About one in fifty has died. The farmers have lost more cattle this season than during any one year that I can remember. The disease seems to me to be bloody murrain, and is induced, I think, by the want of pure drinking-water. Fowls still continue to have the cholera. The man who finds a sovereign remedy for this disease will be immediately acknowledged as a public benefactor.

Floyd.—The disease known here as black-leg is prevailing to a considerable extent among cattle. It is a very fatal malady. Chicken cholera has been very destructive during the past season, and thousands of fowls have died. No remedy is known for the disease.

Goochland.—The epizooty is prevailing to some extent among horses in this county. A local disease called murrain has afflicted cattle in the middle of the county during the course of the year.

Greene.—At present a mild form of epizooty is prevailing among the horses of this county; so far as I have been able to learn it has proved fatal in but one case.

Hanover.—Cattle occasionally die from murrain or bloody flux. Our hogs have been almost exempt from disease during the past year. Sheep are more liable to disease than any other class of animals. We annually lose large numbers of fowls by the disease known as cholera.

Henry.—Cattle that have had the distemper and recovered are rated higher than those that have never had it, as they are believed to be safe from a second attack. This is a very fatal disease, however, and a great many cattle annually die of it. Hogs attacked by swine plague are of but little value should they recover, as they never amount to much in the way of fattening. A great many chickens annually die of cholera.

Highland.—Influenza is now raging among horses in this county. Cholera prevails to some extent among hogs, rot among sheep, and cholera and dysentery among fowls.

James City.—Hogs and fowls in this county are suffering with the so-called cholera. A large mast this fall, and hogs were never before so fat. They are already fat enough to slaughter.

King George.—Farm stock of all kinds have been remarkably free from disease during the past year in this county.

King and Queen.—While we have lost but few farm animals by disease during the past year, our losses among fowls have been quite heavy.

Lancaster.—The epizooty is prevailing generally among our horses and mules, but it is of so very mild a type that no deaths have been caused as yet. In some localities the cholera has destroyed from 90 to 100 per cent. of the fowls.

Matthews.—Epizooty in a mild form is prevailing among the horses in this county. No deaths. I lost a few sheep, but a *post-mortem* examination failed to reveal the cause of death. They were very fat. The loss of fowls by cholera continues quite large. Eggs and poultry are a source of considerable revenue, and but for this disease the business would be greatly increased.

Mecklenburg.—Our farmers are paying considerable attention to the raising of horses. Colts are liable to distemper, although few die of the affection. Lately we have had the epizooty in a very mild form; no deaths. The only disease we have had among cattle is distemper, which is infectious, and carries off a very heavy proportion of those attacked. Hog cholera has not been so prevalent this year as formerly, and has done but little damage. Our loss of fowls this year from "cholera" is probably greater than the loss in all farm animals from infection and contagious diseases.

Montgomery.—I know of no disease among cattle except in one or two localities of the county. Cattle brought here from North Carolina have ticks on them, and when these ticks are communicated to native cattle the animals sicken and die. Several instances of this kind have occurred during this and in previous years. It is not safe to bring cattle from the region east of the Blue Ridge, except during the winter months. The disease is the most fatal one I know, and almost invariably communicated to all native stock coming in contact with the imported animals.

Nottoway.—The old-fashioned distemper is now prevailing among cattle in this county, and deaths are quite frequent. Some disease prevails among swine and fowls, but the losses, so far, have been comparatively light.

Patrick.—Glanders is prevailing to a considerable extent among horses in this and adjoining counties. The only preventive or cure for this disease is to kill all the affected animals. Occasionally a horse dies of common distemper. Considerable disease has prevailed among hogs, and the losses have been quite heavy. Cholera prevails with its usual virulence among fowls.

Rappahannock.—The epizooty has prevailed among horses in this county during the past season. No deaths have occurred. Cattle are often attacked by murrain and black-leg; this disease is mostly confined to calves and yearlings. We have lost some late lambs by an unknown disease, and a good many fowls by the disease known as cholera.

Rockbridge.—Distemper is the only contagious disease I have to mention as prevailing among our horses, and it seldom proves fatal. Cholera among hogs and cholera and gapes among chickens are reported as prevailing in different localities. Among fowls the destruction has been great.

Warren.—The epizooty and distemper are now prevailing among horses in this county. Sheep have suffered some from flukes. This trouble is brought on by local causes, such as drinking impure water and grazing on low lands. Remedy, frequent change of pasture.

Washington.—A few cases of black-leg have occurred among calves wintered on low lands. The epizooty is prevailing among horses in a very mild form. Chickens are affected with cholera; a disease which generally proves fatal.

Warwick.—The epizooty made its appearance among horses in this county about a fortnight ago. So far I have heard of but one death. Cholera among fowls has prevailed with its usual fatality.

WASHINGTON TERRITORY.

San Juan County.—Our principal losses of farm animals occur from neglect, and are confined almost exclusively to cattle and sheep.

Thurston.—Scab is the only disease which seriously affects our sheep. The loss is mostly in wool, as those affected with the disease generally lose their wool. Taking this view of the matter, this loss is greater than the value of the sheep.

WISCONSIN.

Buffalo County.—The value of the losses among farm animals by disease during the past year, I think, will not vary much, for this county, from the following estimates: Horses, $3,000; cattle, $1,500; hogs, $1,000; sheep, $6,000; fowls, $100. As regards losses among sheep, a large proportion was caused by depredations of dogs.

Chippewa.—Sheep in this county are a good deal troubled with a snuffling and running at the nose. Horses are having what is called the epizooty. The disease has manifested itself in a mild form, and where proper care has been observed no serious results have followed.

Dane.—The epizooty is prevailing among our horses, but in a very mild form. Hog cholera exists in some localities, but is not prevailing so widely as in some years. The only disease now affecting sheep is grub in the head. Cholera prevails to a considerable extent among fowls.

Dodge.—The epizooty prevailed quite extensively during the month of November, but it was very mild and caused no deaths. Foot rot has occasionally prevailed among sheep, but no fatal results have followed.

Greene.—I have found it next to impossible to get at the value of swine lost by cholera in this county. In some localities they are perfectly healthy, while in others the disease is doing considerable damage, though nothing as compared to some former years.

Juneau.—Hogs fare worse, so far as disease is concerned, than any other class of farm animals. Horses come next. A large number of both classes have been lost during the past year.

Kenosha.—Bloody murrain occurred among some cattle brought from the Chicago stock-yards to this county to feed. After grazing for about a month, five were attacked by the disease and all died.

Marquette.—Some yearling cattle have been affected with a disease similar to distemper. It continued with them in a mild form during the summer, and later in the season broke out more extensively and in a more malignant form.

Monroe.—A large number of horses have been lost during the year by distemper. While the condition of farm animals is very good, a great many have been lost by various diseases during the year.

Oconto.—Farm animals in this county have been unusually healthy during the past season. A few deaths have occurred among hogs from swine plague.

Saint Croix.—The epizooty has prevailed quite extensively among horses in this county. A few cases of glanders have been reported. The animals affected were shot.

Sauk.—The only contagious disease that has affected horses during the past year has been the epizooty. But a great many horses have gone blind, supposed to have been caused by previous epizootic disorders. Hog cholera is prevailing in one town.

Vernon.—Horses, cattle, sheep, and fowls have been healthy during the past season. A disease among hogs reached here this year for the first time. It commenced early in the spring. The first symptom is a cough, or a weaving, bellows-like motion of the sides. This is generally followed by diarrhea, after which death soon ensues. A large per cent. of the losses are among pigs.

Washington.—The epizooty has prevailed quite generally among horses in this county. No deaths reported.

Waukesha.—Hog cholera has prevailed to a considerable extent in this county, and the value of our losses from the disease will perhaps exceed $20,000. Foot rot is reported as existing among some flocks of sheep in the southern part of the county.

WEST VIRGINIA.

Barbour County.—Calves and yearlings are subject to a disease known here as black leg. We have no remedy. About all die that are attacked by the disease. Fowls are badly afflicted with cholera.

Berkeley.—We have no infectious nor contagious diseases among farm animals in this county, not even hog cholera, which prevailed here so generally a few years ago.

Boone.—With the exception of epizooty and distemper horses are free from all contagious diseases. Hog cholera has prevailed throughout the mountain counties and has been very fatal. A few cases of rot among sheep have been reported. A great many young fowls die of cholera.

Doddridge.—The most common and fatal disease to fowls is gapes. A good preventive is found in wood ashes. It is administered by placing the food on the ashes. No contagious disease prevails among farm animals.

Logan.—During the year both horses and cattle have been visited with a severe type of some kind of distemper. Some losses have occurred, but not a great many. Hogs have been afflicted with cholera as usual, but the losses have not been very heavy.

Mercer.—We have had some hog cholera in this county; probably one hundred head have died in all. Some fatal cases of bloody murrain among cattle have been reported. Foot rot among sheep prevails to a limited extent.

Morgan.—Horses are now suffering with distemper or epizooty. Sheep have been afflicted with scab, and fowls with the disease known as cholera.

Nicholas.—Contagious diseases prevail more extensively among hogs and sheep than among other classes of farm animals. Among the former the cholera frequently proves very destructive, and among the latter the rot and scab are often quite troublesome. Cholera also prevails among fowls to a considerable extent.

Ohio.—I estimate the value of losses occasioned by disease among our farm animals for the year at about $12,000. Some few cases of hog and chicken cholera have been reported.

Tucker.—Fowls, especially chickens, have suffered terribly during the past few months with what is generally known as cholera. We have no remedy for this disease.

Tyler.—The horses of this county have been affected with epizootic distemper, but in rather a mild form. A good many cattle, generally calves and yearlings, suffer with a disease known as black-leg. About all those attacked die. Hogs and fowls are frequently destroyed in large numbers by the disease known as cholera.

Wyoming.—Hogs are all dying with cholera. Some persons have lost all they had. I think that probably two-thirds of all the hogs in the county have died, and the disease is still raging.

INDEX.

Page.

Acclimatization, bacteria due to 53
Acid, benzoic, antiseptic influence of, upon fowl-cholera virus 9, 61
    swine-plague virus 8, 26
  effect of, on development of swine-plague micrococcus 78
 boracic, and sulphate of potassium, effect of, on fowl-cholera virus 32
  effect of, on fowl-cholera virus 32, 33
 carbolic, disinfectant in fowl cholera 70
  effect of, on fowl-cholera virus 9, 33
    swine-plague virus 8, 26
    development of swine-plague micrococci 77
    vitality of swine-plague micrococci 77
  in swine plague, value of 181
  swine plague arrested by 10
  treatment with, in swine plague 10
 salicylic, antiseptic influence of, upon fowl-cholera virus 9
    swine-plague virus 8, 26
  effect of, on development of swine-plague micrococcus 79
 sulphuric, as disinfectant in fowl cholera 70
  effect of, on fowl-cholera virus 32
Act, contagious diseases of animals, of Great Britain 10, 237
Acute bronchitis 233
  pathology and morbid anatomy of 234
  symptoms of 233
Advantages of inoculation with devitalized blood in swine plague 144
Agent, virulent, in septicæmia 63
Air, free, decreases virulence of swine-plague germ 117
 limited supply of, increases virulence of swine-plague germ 117, 123
   influence upon disease germs, argument from yellow fever 121
     example from typhoid fever 122
     in Asiatic cholera 123
Algerian sheep, nature of immunity of, from charbon 304
Alcoholic extract of blood in fowl cholera not virulent 31
Alcohol, effect of, on fowl-cholera virus 32
Alabama, condition of farm animals in 329
American cattle condemned in Liverpool not affected with pleuro-pneumonia 11
  diseases in, in 1878 218
  English embargo on, because of pleuro-pneumonia 205
  excluded by orders of privy council of Great Britain 10
  landed in Great Britain, correspondence concerning detection of pleuro-pneumonia in 219
    Liverpool, interstitial pneumonia in 11
  shipped to England, doubt concerning pleuro-pneumonia in 281
    statistics of pleuro-pneumonia in 201
Anatomy, morbid, of acute bronchitis 234
 pathological, of foot-and-mouth disease 286
Animals condemned for foot-and-mouth disease in Liverpool 204
   pleuro-pneumonia in Liverpool 204
 contagious diseases of, orders of Great Britain concerning 237
 foreign, landed in Great Britain, diseases among 216
    foot-and-mouth disease among 216
    pleuro-pneumonia among 216
    sheep scab among 216
    swine fever among 216
  wharves for, in England 215
 from the United States landed at Liverpool, statistics of 204
 herding of, to be avoided in swine plague 129
 insusceptible, breeding from 70
Annual report of the veterinary department of the privy council of Great Britain 209
Anthrax among cattle in New York 312
   lesions of 313
   prevention of 314
   supposed causes of 313
   symptoms of 313
   in the Northwest 311
 Chauveau's experiments with 89
 contagium of 61
 distributed by earth-worms 62
 germs, preservation of, in graves 119
 in New Mexico 317
 in Tennessee 322
 malignant, mitigation of poison of 117
 preventive influence of first attack of 62

Page.
Anthrax spores distributed by earth-worms ... 120
Antiseptics, influence of, in swine plague ... 10
upon virus of fowl cholera ... 9, 31, 329
swine plague ... 8, 25
value of, in swine plague ... 181
Appendix to Dr. Salmon's report ... 73
Aphthous fever (see Foot-and-mouth disease) ... 282
Arkansas, condition of farm animals in ... 330
Ashes, wood, a preventive for swine plague ... 125
Asiatic cholera, example in, of influence of limited air supply on disease germs ... 121
Atmospheric temperature, influence of, on body temperature ... 80
Attacks of fowl cholera prevent subsequent inoculation ... 35
Bacilli ... 59, 64, 66, 67, 68, 296, 297
kinds present in putrefying liquids ... 57
mixed, effects of inoculation with ... 68
Bacillus ... 65
Bacillus amylobacter ... 54, 68
Bacillus anthracis ... 26, 54, 61, 62, 64, 66, 118, 119
Buchner's observations on ... 118
destroyed by oxygen ... 119
development of ... 57
durability of spores of ... 63
of swine plague ... 16
germs of ... 8
spores of, not destroyed by oxygen ... 119
transformed from *Bacillus subtilis*, and *vice versa* ... 118
Bacillus subtilis ... 54, 66
Bacillus suis ... 54
misnamed ... 68
Bacteria ... 53
are they essential to protection? ... 137
development of, in injuries and non-contagious diseases ... 58
due to acclimatization ... 53
effect of injecting into tissue ... 58
Bacteria form, special, to each septic disease ... 58
germs, penetrate blood and tissues in health ... 57
indestructibility of ... 60
infection and intoxication ... 135
injections rendered injurious ... 58
inoculation with, effect of ... 58
intoxication and bacteria infection ... 135
Bacteria lineola ... 183
Bacteria not directly injurious in blood and tissues in health ... 58
of fowl cholera identical with virus ... 9
of swine-plague virus, effect of disinfectants upon ... 76
pathogenic ... 62
separation of, by diffusion ... 66
filtration ... 66
freezing ... 66
skimming ... 56
septic, when injurious ... 58
spontaneous in urine, experiments with ... 76
theory ... 57
caution concerning ... 60
how established ... 61
Bacteriaceæ ... 57
classification of ... 55, 57
Davaine's classification of ... 56
distribution of, in nature ... 52
form of ... 61
nature of ... 57
place in nature ... 52
Bacteridium ... 53
Bacterium ... 53, 55
of swine plague identical with that of *mal rouge* ... 8
Bacterium termo ... 68, 183, 188, 296, 297
in the mouth ... 58
in swine plague ... 16
schizophytæ of swine plague disappear with appearance of ... 183
Beggiatoa ... 55
Benzoate of soda in swine plague, value of ... 182
treatment with, in swine plague ... 19
Benzoic acid, antiseptic influence of, upon virus of swine plague ... 8, 26
effect of, on development of swine-plague micrococcus ... 78
effect of, on fowl-cholera virus ... 31
Bioplasm, granular, in fowl cholera ... 45
or its granules, theory of ... 59
Birds and fowls, symptoms of foot-and-mouth disease in ... 286
Black leg ... 321
remedy for ... 325
Blood, alcoholic extract of, not virulent in fowl cholera ... 21
and tissues, bacteria not injurious in, in health ... 58
devitalized, inoculation with, in swine plague, advantages of ... 144
inoculations with, in swine plague, disadvantages of ... 145
precautions to be observed in ... 144
protection with, Law's experiments in ... 141
in anthrax, Toussaint's experiments ... 141

Page.
Blood, free nuclei in, in fowl cholera 44
  in health, bacteria in 57
  of suffocated pig, inoculations with, in swine plague 145
  period of virulence of, in fowl cholera after death 31
  putrid, and septicæmia, difference between 63
Bloody murrain 322
Bodies, undetermined, in fowl cholera 48
Body temperature, influence of atmospheric temperature on 80
Boracic acid and sulphate of potassium, effect of, on fowl-cholera virus 32
  effect of, on fowl-cholera virus 33
Borate of soda, effect of, on development of micrococci of swine plague 78
Borax, antiseptic influence of, upon swine-plague virus 8, 26
Bronchitis, acute, pathology and morbid anatomy of 234
  symptoms of 233
  in cattle 232
    causes of 232
    division of 232
Breeding from unsusceptible animals 70
Buildings, railroad, dangers from, in swine plague 131
California, condition of farm animals in 331
Camphor, carbolated, effect of, on fowl-cholera virus 33
Capillary vacuum tubes, method of making 22
Carbolated camphor, effect of, on fowl-cholera virus 33
Carbolic acid, effect of, on development of swine-plague micrococci 77
    fowl-cholera virus 33
    vitality of swine-plague micrococci 77
  preference for, in treatment of swine plague 10
  swine plague arrested by 10
  treatment in herds, of swine plague 194
    with, in swine plague 10
  value of, in swine plague 181
Cars, railroad, dangers from, in swine plague 131
Cattle affected with pleuro-pneumonia shipped to England, sources of 269
  American, condemned at Liverpool, not affected with pleuro-pneumonia 11
    English embargo on, because of pleuro-pneumonia 205
    excluded by orders of privy council of Great Britain 10
    landed in Great Britain, correspondence concerning detection of pleuro-pneumonia in 219
    landed at Liverpool, interstitial pleuro-pneumonia in 11
    sent to England, statistics of pleuro-pneumonia in 201
  bronchitis in, causes of 232
    division of 232
  diseases among, in Louisiana 322
    in America in 1878 218
  English orders relating to importation of 213
  fever, Southern 206
    extent of losses from 207
    Texas, experiments with 294
      microscopic investigation of 294
      morbid changes of 292
      origin of outbreak of 294
      symptoms of 291
  in New York, anthrax among 312
  insurance on 207
  in the Northwest, anthrax among 311
  millet dangerous for 323
  symptoms in, in foot-and-mouth disease 283
  weeds poisonous to 321
Causes of bronchitis in cattle 232
  supposed, of anthrax in New York 313
Caution concerning bacteria theory 60
Changes, morbid, in swine plague 156
Charbon (see Anthrax).
  earth-worms, bearers of germs of 301
  etiology of 298
  immunity from, by preventive inoculation 309
  preventive inoculation against, Toussaint's experiments 303
  production of, by pastures 304
Chauveau's experiments with anthrax 89
Chemical products, alone, is protection secured by 137
  of swine-plague germ, influence of 135
Chicken cholera, Pasteur's method with 117
Chloride of zinc, antiseptic influence of, upon swine-plague virus 8, 14, 26, 72
  effect of, on swine-plague micrococci 79
Cholera, Asiatic, example in, of influence of limited air supply on disease germs 121
Circular letter concerning fowl cholera 11
Classification of bacteriaceæ 53, 55, 57
  schizomycetes, confusion in 54
Closed spaces beneath floors to be avoided in swine plague 130
Cocco-bacteria septica 53
Coccos 53
Cold weather, susceptibility to fowl cholera increased by 40
Colonization of swine plague, stage 191
Colorado, condition of farm animals in 332
Condition of farm animals in Alabama 329
    Arkansas 330
    California 331

Page.
Condition of farm animals in Colorado 332
  Connecticut 332
  Dakotah Territory 332
  Delaware 333
  Florida 333
  Georgia 334
  Idaho Territory 336
  Illinois 336
  Indiana 339
  Iowa 340
  Kansas 342
  Kentucky 345
  Louisiana 347
  Maine 347
  Maryland 348
  Massachusetts 348
  Michigan 349
  Minnesota 349
  Mississippi 351
  Missouri 352
  Montana Territory 356
  Nebraska 356
  Nevada 357
  New Hampshire 357
  New Jersey 358
  New Mexico 358
  New York 358
  North Carolina 359
  Ohio 361
  Oregon 362
  Pennsylvania 363
  South Carolina 365
  Tennessee 366
  Texas 368
  Utah 370
  Vermont 370
  Virginia 371
  Washington Territory 373
  West Virginia 373
  Wisconsin 374
Confined spaces, crowding animals in, in swine plague to be avoided 130
Connecticut, condition of farm animals in 332
Contagia, influence of recent investigations upon theories of 48
Contagion, easy destruction of, by ventilation 60
  of fowl cholera, easily controlled 65
  theories of, how established 47
Contagious diseases act of Great Britain [illegible]
  important suggestions concerning, of animals act Great Britain 277
  medical treatment of 60
  of animals, orders for Great Britain concerning 277
  prevention of, influence of recent investigations upon 63
  vaccination of 63
  pleuro-pneumonia, microscopic characteristics of 275
    second report of Dr. Lyman on 187
    third report of Dr. Lyman on 286
Contagium of anthrax 61
  foot and mouth disease, character of 287
  fowl cholera 64
  septicæmia 63
  swine plague 65
Correspondence concerning detection of pleuro-pneumonia in American cattle landed in Great 194
  Britain 279
Course and termination of foot and mouth disease 286
Cultivated fowl-cholera virus, preservation of 59
  schizophytæ, preventive inoculation with, in swine plague 194
  virus, inoculations with 124
    of swine plague, deadly 81
      inoculations with 115
        a preventive 115
Cultivation experiments, reliability of 59
  of free granules of fowl cholera in flasks 47
    on slides 46
Curative measures in foot and mouth disease 296
Dakota, condition of farm animals in 332
Danger from market yards in swine plague 131
  railroad buildings in swine plague 131
    cars in swine plague 131
  vessels in swine plague 131
Davaine's classification of bacteriaceæ 52
Deductions, hygienic and prophylactic, from inoculation with swine-plague virus 135
Definition of swine plague 134
Delaware, condition of farm animals in 333
Desiccation, influence of, upon virus of swine plague [illegible]
Destruction of contagion, easy, by ventilation 60
Detection of pleuro-pneumonia in American cattle landed in Great Britain, correspondence concerning 279
Detmers, Dr., experiments with preventives of swine plague 16

Page.

- Development of bacteria in injuries and non-contagious diseases 58
  - schizophytæ of swine plague influenced by weather 189
  - swine plague micrococci, effect of borate of soda upon 78
    - carbolic acid upon 77
    - chloride of zinc upon 79
    - heat upon 79
    - quassia on development of 79
    - salicylic acid upon 79
    - sulphate of quinine upon 78
- Devitalized blood, inoculations with, in swine plague, advantages of 144
  - disadvantages of 145
  - precautions to be observed 144
  - protection with, Law's experiments 141
    - in anthrax, Toussaint's experiments 141
  - virus as a preventive of fowl cholera 36
- Differences of observations in swine plague, explanation of 67
- Dilution of virus, effect of 30, 89
- *Diplo-bacteria* 52
- *Diplo-coccus* 52
- Disadvantages of inoculation with devitalized blood in swine plague 145
- Disease, foot and mouth (see Foot and mouth disease) 282
  - landed in England 209
  - non-existence of, in the West 319
  - germ, influence of limited air supply on—
    - argument from yellow fever 120
    - example in Asiatic cholera 121
    - example from typhoid fever 122
    - preserved by protective inoculation in swine plague 184
  - spread of, influence of fœtus in 138
  - lung, from Liverpool, microscopic characteristics of 274
- Diseases among cattle in Louisiana 322
  - foreign animals landed in Great Britain 216
  - cattle, in America in 1878 218
  - contagious, act of Great Britain 10
    - medical treatment of 69
    - of animals, act of Great Britain 237
      - orders for Great Britain concerning 237
    - prevention of, influence of recent investigations on 60
    - vaccination of 69
  - non-contagious, development of bacteria in 58
  - of animals, value of investigations of 7
  - of swine, extent of 7
    - extract from President's message concerning 231
  - septic, special bacteria form for each 53
- Disinfectants, carbolic and sulphuric acids as, in fowl cholera 70
  - effect of, upon bacteria of swine-plague virus 76
  - influence of, upon micrococcus of swine plague 25
  - loose dry earth as, in swine plague 133
- Disinfection, ventilation an efficient means for 18
- Distribution of schizomycetes in nature 55
  - wide, of bacteriaceæ 52
- Division of bronchitis in cattle 232
- Dr. Detmer's third report on investigation of swine plague 153
- Dr. Salmon's experiments in swine plague, object of 13
- Drains, close, objection to, in swine plague 131
- Drawbacks to inoculation with devitalized blood 145
  - preventive inoculation with devitalized virus in swine plague 134
- Dry seasons in particular soils dangerous in swine plague 132
- Drying, effect of, upon fowl-cholera virus 30
  - swine-plague virus 16
- Dust a cause of swine plague 321
- Earth, loose dry, as disinfectant in swine plague 133
  - worms distribute anthrax spores 62, 120, 301
- *Echinorhynchus gigas* in swine 17, 22
- Effects of injecting bacteria into tissues 56
- Effect of inoculating urine with micrococci of swine plague 76
  - inoculation with bacteria 56
    - mixed *bacilli* 56
- Embargo, English, on American cattle because of pleuro-pneumonia 205
- England, American cattle sent to, statistics of pleuro-pneumonia in 201
  - Dr. Lyman's visit to, proceedings of 10
  - foreign animals wharves in 215
  - pleuro-pneumonia in American cattle shipped to, doubt concerning 281
  - sources of cattle affected with pleuro-pneumonia shipped to 269
- English embargo on American cattle because of pleuro-pneumonia 205
  - orders relating to importation of cattle 213
- Etiology of charbon 298
- Examinations, post-mortem, in swine plague 158
- Experiments, cultivation, reliability of 50
  - first series of, Dr. Salmon in swine plague 13
  - later, of Dr. Law, record of 147
  - objects of Dr. Salmon's, in swine plague 13
  - with anthrax, Chauveau's 89
    - bacteria spontaneous in urine 76
    - fowl cholera, results obtained in 40
    - preventives of swine plague by Dr. Detmers 10

Page.
Experiments with swine plague ... 164
    in progress ... 115
    results of ... 176
    summary of ... 178
  Texas cattle fever ... 294
Explanation of differences of observations in swine plague ... 67
Extent and location of swine plague in the United States ... 204
Extent of losses from Southern cattle fever ... 207
Extermination of pleuro-pneumonia, recommendation for ... 206
Extract from President's message concerning diseases of swine ... 231
Fatality of swine plague hastened by reinoculation ... 114
    germ, mitigation of ... 117
Feeding, high, recommended ... 325
Ferments, unorganized, theory of ... 49
Fever, aphthous (see Foot and mouth disease) ... 282
  Southern cattle ... 206
    extent of losses from ... 207
  splenic, in Missouri ... 325
    Virginia ... 322
  Texas cattle, experiments in ... 294
    microscopic investigation of ... 294
    morbid changes of ... 292
    origin of outbreak of ... 294
    symptoms of ... 291
  typhoid, example from, on influence of limited air supply on disease germs ... 123
  yellow, argument from, on influence of limited air supply on disease germs ... 120
Fleming, Dr. George, to Dr. Lyman, letter on pleuro-pneumonia ... 197
Floors, wooden, objected to in swine plague ... 130
Florida, condition of farm animals in ... 333
Fœtus, influence of, in spread of disease ... 138
Foot and mouth disease ... 282
    among foreign animals landed in Great Britain ... 216
    animals condemned for, in Liverpool ... 204
    causes of ... 283
    character of contagium of ... 287
    curative measures in ... 288
    course and termination of ... 286
    landed in England ... 209
    modes of infection with ... 287
    no immunity from, by previous attack ... 286
    non-existence of, in the West ... 319
    pathological anatomy of ... 286
    sanitary measures in ... 288
    symptoms of, in birds and fowls ... 286
      cattle ... 283
      horses ... 285
      sheep and goats ... 285
      swine ... 285
    vitality of virus of ... 287
Foreign animals landed in Great Britain, diseases among ... 216
      foot and mouth disease among ... 216
      pleuro-pneumonia among ... 216
      sheep scab among ... 216
  wharves in England ... 215
Form of the bacteriaceæ ... 57
Fowl cholera (see Chicken cholera) ... 27
  alcoholic extract of blood in, not virulent ... 31
  antiseptic effect of salicylic acid upon virus of ... 31
  attacks of, protect against subsequent inoculation ... 35
  bacteria of, identical with virus ... 9
  carbolic and sulphuric acids, disinfectants in ... 70
  characteristics of ... 40
  circular letter concerning ... 11
  contagion easily controlled ... 9
  contagious ... 40
  contagium of ... 64
  contracted from infected habitations ... 30
  Dr. Salmon's investigations of ... 9
  free granules of ... 46
    cultivation of ... 46
      in flasks ... 47
      on slides ... 46
  free nuclei in blood in ... 44
  germs of, how spread ... 40
    not transported by atmosphere ... 29
    taken by mouth ... 70
  granular bioplasm in ... 45
  hematoblasts, so-called, in ... 45
  how introduced ... 70
  influence of antiseptics upon virus of ... 9
  insusceptibility not due to presence or absence of chemical substance in body ... 9
  its inoculation possible ... 27
  leucocytes in ... 45
  means for checking ... 70
  medical treatment of ... 71
  microscopic investigations in ... 44

Page.

- **Fowl cholera**, mitigated virus of, attempts to obtain 39
  - period of incubation of 42
    - virulence of blood after death in 31
  - post-mortem appearances in 42
  - prevention of, department circular concerning 314
  - preventive treatment of 71
  - results of experiments with 40
  - rules for prevention of 9
  - some fowls resist attacks of 35
  - susceptibility to, increased by cold weather 40
  - symptoms of 41, 70
  - transmissible 28
  - transmission of, means for 28
  - undetermined bodies in 48
  - virus, cultivated preservation of 39
    - difference in nature of antiseptic organisms 32
    - effect of alcohol upon 32
      - benzoic acid upon 31
      - boracic acid upon 33
      - boracic acid and sulphate of potassium upon 32
      - carbolated camphor upon 33
      - carbolic acid upon 33
      - drying upon 30
      - heat upon 33
      - iodine upon 33
      - putrefaction upon 30
      - sulphuric acid upon 32
      - when taken with food 29
  - virus of, not taken up and carried through air 9
    - organs containing 28
    - period of incubation of 27
- **Fowls**, symptoms of foot and mouth disease in 286
- **Free granules** in fowl cholera 46
  - cultivation of, in flasks 47
    - on slides 46
- **Free** nuclei in blood in fowl cholera 44
- **General** results of inoculation with cultivated swine-plague virus 128
- **Georgia**, condition of farm animals in 334
- **Germs**, anthrax, preservation of, in graves 119
  - of charbon, earth worms bearers of 301
  - of fowl cholera, how spread 40
    - not transported by atmosphere 29
    - taken by mouth 70
  - of swine plague, chemical products of growing, diminishes virulence of disease 10
    - influence of, produces insusceptibility to disease 10, 117
    - influence of chemical products of 135
    - mitigation of virulence and fatality of 117
- ***Gliacoccus*** 52
- **Granular** bioplasm in fowl cholera 45
- **Granules**, free, in fowl cholera 46
  - cultivation in flasks 47
    - on slides 46
  - of bioplasm, theory of 50
- **Great Britain**, contagious diseases of animals act of 10, 257
- **Growth** retarded by protective inoculation in swine plague 134
- **Heat**, effect of, on development of swine-plague micrococcus 79
  - fowl-cholera virus 33
  - influence of, upon virus of swine plague 8
- ***Hematoblasts***, so-called, in fowl cholera 45
- ***Hematopinus suis*** 90
- **Herding** animals in swine plague to be avoided 129
- **High** feeding recommended 324
- **Hog cholera**, often confounded with other diseases 143
  - so-called, often due to intestinal vermin 143
- **Hogs** condemned for swine fever in Liverpool 204
- **Horses**, symptoms of foot and mouth disease in 285
- **Hygienic** deductions from inoculations with cultivated swine-plague virus 128
- **Hyposulphite** of soda, treatment with, in swine plague 15
- **Idaho** Territory, condition of farm animals in 336
- **Illinois**, condition of farm animals in 336
  - diminished extent and virulence of swine plague in 7
  - northern limit of swine plague 7
- **Immunity** by previous attack, none in foot and mouth disease 286
  - from charbon by preventive inoculation 309
    - swine plague produced by first attack 183
  - of Algerian sheep, nature of, from charbon 304
- **Importation** of cattle, English orders relating to 213
- **Incubation**, period of, of virus of fowl cholera 27
  - of fowl cholera, period of 42
- **Indestructibility** of bacteria 60
- **Indiana**, condition of farm animals in 339
- **Infected** herds, inoculation of, in swine plague 135
- **Infection**, bacteria, and bacteria intoxication 135
  - modes of, in foot and mouth disease 287
  - septic, swine plague possibly a modified form of 115
  - swine plague, exposure to, comparable with inoculation with minimum quantity 113

Page.

Infectious principle of swine plague 184
    not bacteria, but schizophytæ 185
Influence of fœtus in spread of disease 138
    protective, of chemical products of growing swine-plague germ 135
Injections of bacteria into tissues, effects of 56
    bacteria, rendered injurious 56
Injuries, development of bacteria in 58
Inoculation, communication of swine plague by 13
    method of, of swine-plague virus treated with chloride of zinc 14
    of fowl cholera possible 27
        prevented by previous attacks 35
    of infected herds in swine plague 135
    of swine plague, disease milder than original 9
        with primary virus 113
    preventive against charbon, Toussaint's experiments 303
        immunity from charbon by 309
        with cultivated schizophytæ in swine plague 194
    protective in swine plague 183
        effective only in same disease 143
        in swine plague, growth retarded by 134
            preserves disease germ 134
            with mitigated virus 134
                drawbacks to 134
    results of, with cultivated virus of swine plague 18
    with bacteria, effects of 56
        blood of suffocated pig in swine plague 145
        cultivated swine-plague virus, a preventive 115
            deductions, hygienic and prophylactic 128
            general results of 128
        devitalized blood in swine plague, advantages of 144
            disadvantages of 145
            precautions to be observed 144
        excess of swine-plague virus 113
        minimum quantity of swine-plague virus 113
        mixed *bacilli*, effects of 56
        septic virus, effects of 94, 98
        swine-plague virus 113
            cultivated in cows' milk in free air 124
                egg albumen in free air 124
                human urine in free air 125
            dried on quill 125
            modified 124
            preserved in closed vessels 128
            preserved with limited supply of oxygen 126
        urine containing micrococci of swine plague, effects of 76
Insurance on cattle 207
Insusceptibility to swine plague induced by chemical products of growing germ 10, 117
Insusceptible animals, breeding from 70
Internal morbid changes of Texas fever 292, 293
Interstitial pneumonia, chronic form in cattle landed in Liverpool 11
Intestinal vermin, hog cholera, so called, often due to 143
Intoxication, bacteria and bacteria infection 135
Investigations, microscopic, in fowl cholera 44
        of Texas cattle fever 294
    of swine plague, Dr. Law's 81
        Dr. Salmon's 13
        third report of Dr. Detmers on 153
    recent, influence of, upon prevention of disease 69
        theories of contagia 48
Iodine, antiseptic influence of, upon virus of swine plague 8, 26
    effect of, on development of swine-plague micrococcus 79
        fowl-cholera virus 33
    treatment with, in swine plague 10
    value of, in swine plague 182
Iowa, condition of farm animals in 340
Kansas, condition of farm animals in 342
Kentucky, condition of farm animals in 345
Laurel a cure for swine plague 321
Law's, Dr. James, experiments in protection with devitalized blood 141
    later experiments, record of 147
    supplemental report on swine plague 116
    third report of 81
Leptothrix 55
Lesions of anthrax among cattle in New York 313
    swine plague, definitely ascertained 13
Leucocytes in fowl cholera 45
Liverpool, animals condemned for foot and mouth disease in 204
        pleuro-pneumonia in 204
    diseased lungs from, microscopic characteristics of 274
    hogs condemned for swine fever in 204
    inspections for pleuro-pneumonia in, review of 278
    pleuro-pneumonia in American cattle landed at 198
        not found 11
    sheep condemned for scab in 204
    statistics of animals landed in, from the United States 204
Location and extent of pleuro-pneumonia in the United States 204
London, inspection for pleuro-pneumonia 202

	Page.
London, pleuro-pneumonia in American cattle landed at	200
Losses, extent of, from Southern cattle fever	207
Louisiana, condition of farm animals in	347
disease among cattle in	322
Lungs affected with pleuro-pneumonia, miscroscopic appearance of	270
diseased, from Liverpool, miscroscopic characteristics	274
healthy, microscopic structure of	272
of pleuro-pneumonia, Dr. W. F. Whitney's microscopic examination of	272
plague of cattle, contagious in Maryland	325
Lyman's, Dr., letter to Commissioner Le Duc, on pleuro-pneumonia	197
Dr. George T. Fleming, on contagious pleuro-pneumonia	197
Lyman, Dr., second report on contagious pleuro-pneumonia	197
third report on contagious pleuro-pneumonia	268
Maine, condition of farm animals in	347
Mal rouge, bacterium of, identical with that of swine plague	8
Manure pits, liquid, objection to, in swine plague	131
Market yards, dangers from, in swine plague	131
Maryland, condition of farm animals in	348
contagious lung plague in	325
Massachusetts, condition of farm animals in	348
Measure of prevention	192
Medical treatment of contagious diseases	69
fowl cholera	71
Mega-bacteria	52
Mega-coccos	52
Meso-bacteria	52
Meso-coccus	52
Michigan, condition of farm animals in	349
Micro-bacteria	52
Micro-coccus	52, 55, 58
in the mouth	56
Micrococcus of swine plague	25
effect of benzoic acid, on development of	78
borate of soda, on development of	78
carbolic acid, on vitality of	77
chloride of zinc on, heat upon	79
development of	79
inoculating urine with	76
iodine on development of	79
Micrococcus of swine plague, effect of quassia on development of	79
salicylic acid on development of	79
sulphate of quinine on development of	78
influence of disinfectants upon	25
Microscopic appearance of lungs affected with pleuro-pneumonia	270
characteristics of contagious pleuro-pneumonia	273
diseased lungs from Liverpool	274
examination, Dr. W. F. Whitney's, of lungs of pleuro-pneumonia	272
investigations of fowl cholera	44
Texas cattle fever	294
structure of healthy lung	272
Minnesota, condition of farm animals in	349
Millet, dangerous food for cattle	323
Mississippi, condition of farm animals in	357
Missouri, condition of farm animals in	352
splenic fever in	325
Mitigated swine-plague virus, protective inoculation with	134
drawbacks to	134
type, protection against swine-plague	81
virus of fowl cholera, attempts to obtain	39
virus, Toussaint's	62
Mitigation of anthrax poison	117
swine plague by artificial means	10
virus	81
virulence and fatality of swine plague germ	117
Modified swine-plague virus, inoculation with	124
Mono-bacteria	52
Meno-coccus	52
Montana Territory, condition of farm animals in	356
Morbid anatomy of acute bronchitis	234
changes in swine plague	156
Texas fever	292, 293
process of swine plague	190
Mortality in swine plague, varying, favored by varying seasons	132
Mouth, *Bacillus subtilis* in	56
Bacterium termo in	56
germs of fowl cholera taken by	70
Sarcina ventriculi in	56
Spirillum in	56
Nature of bacteriaceæ	57
swine-plague virus, microscopic observations upon	19
Nebraska, condition of farm animals in	356
Nevada, condition of farm animals in	357
New Hampshire, condition of farm animals in	357
New Jersey, condition of farm animals in	357
New Mexico, anthrax in	317
condition of farm animals in	358
New York, anthrax among cattle in	312

Page.
New York, condition of farm animals in 358
Non-existence of foot and mouth disease in the West 319
North Carolina, condition of farm animals in 359
diminished extent and virulence of swine plague in 7
Northwest, anthrax among cattle in 311
Nuclei free, in blood in fowl cholera 44
Objection to close drains in swine plague 121
Orders, English, relating to importation of cattle 213
for Great Britain concerning contagious diseases of animals 227, 238, 244, 249, 251, 252, 253
of privy council of Great Britain, excluding American cattle 10
Ohio, condition of farm animals in 361
Oregon, condition of farm animals in 362
Organism causing swine plague, influence of antiseptics upon 8, 25
Origin of outbreak of Texas cattle fever 294
Outbreak of Texas cattle fever, origin of 294
Oxygen, *Bacillus anthracis* spores destroyed by 119
not destroyed by 119
limited supply of, inoculations with swine-plague virus preserved in 136
Pasteur's method with chicken cholera 117
Pastures, production of charbon by 304
Pathogenic bacteria 62
Pathological anatomy of foot and mouth disease 288
Pathology of acute bronchitis 224
Pennsylvania, condition of farm animals in 362
Petalo-bacteria 52
Petalo-coccus 52
Pleuro-pneumonia, among foreign animals landed in Great Britain 216
animals condemned for, in Liverpool 294
contagious, Dr. W. F. Whitney's microscopic examination of lungs of 272
Dr. Lyman's letter to Dr. Fleming on 197
microscopic characteristics of 273
second report of Dr. Lyman upon 197
third report of Dr. C. P. Lyman upon 208
English embargo on American cattle because of 205
in American cattle condemned at Liverpool, not found 11, 281
landed in Great Britain, correspondence concerning detection of 219
Liverpool 198
London 200
shipped to England, doubt concerning 281
inspection for, in London 202
in United States, extent and location of 294
letter from Dr. Fleming to Dr. Lyman on 198
of Dr. Lyman to Commissioner LeDuc on 197
lungs affected with, microscopic appearance of 270
recommendations for extermination of 206
review of inspections for, in Liverpool 278
sources of cattle affected with, shipped to England 209
statistics of, in American cattle sent to England 201
Pneumonia, interstitial, chronic form in cattle landed in Liverpool 11
Pig, suffocated, blood of, inoculation with in swine plague 145
Pigs, healthy, inoculated, subject to swine plague 182
Pits, liquid manure, objection to in swine plague 131
Post-mortem appearances in fowl cholera 43
examinations in swine plague 158
Potassium sulphate and boracic acid, effect of on fowl-cholera virus 82
Potency of swine-plague virus, danger of increasing by storage 129
Preservation of anthrax germs in graves 119
of cultivated virus of fowl cholera 39
Prevention of contagious diseases, influence of recent investigations upon 60
Products, chemical, alone, is protection secured by 137
Protection, are bacteria essential to 137
by devitalized blood, Law's experiments 141
Putrid blood different from septicæmia 68
Recent investigations, influence of, on prevention of contagious diseases 60
Record of Dr. Law's later experiments 147
Reinoculation of swine plague, hastens fatality of 114
Reliability of cultivation experiments 59
Remedy for black leg 325
snifles in sheep 323
Report, annual, of the veterinary department of the privy council of Great Baitain 209
of Dr. James Law, third annual 81
of Dr. Salmon, appendix to 72
of the privy council of Great Britain 325
supplemental, on swine plague by Dr. Law 116
third, of Dr. Detmers, on investigations, of swine plague 158
Results of experiments in fowl cholera 40
swine plague 178
Review of inspections for pleuro pneumonia in Liverpool 278
Salicylic acid, antiseptic effect of, on fowl-cholera virus 31
effect of, on development of swine-plague micrococcus 79
Salmon, Dr., appendix to report of 72
investigation of fowl cholera 13
reasons for conclusions concerning bacillus of swine plague 9
review of theories concerning swine-plague bacillus 9
Sanitary measures in foot and mouth disease 288
..... 55

	Page.
Sarcina ventriculi in mouth	56
Scab, sheep condemned for, in Liverpool	204
landed in England	209
Schizomycetes	53, 57
Schizophytæ, cultivated, preventive inoculation with, in swine plague	194
of swine plague, development of, influenced by weather	189
disappear with appearance of *Bacterium termo*	188
of Cohn	57
Sclerostoma dentatum in swine	22
Seasons, varying, favor varying mortality in swine plague	132
wet, effect of, on certain soils in swine plague	133
Septic bacteria, when injurious	56
disease, special bacteria form for each	53
organisms, difference in nature of fowl-cholera virus and	82
virus, inoculation with	94
Septicæmia, contagium of	63
virulent agent of	63
Septicæmic blood, different from putrid	63
Sheep, Algerian, nature of immunity of from charbon	304
and goats, symptoms of foot and mouth disease in	285
condemned for scab in Liverpool	204
remedy for sniffles in	325
scab among foreign animals landed in Great Britain	217
landed in England	209
Slides, cultivation of free granules of fowl cholera on	46
Sniffles in sheep, remedy for	323
Soda, benzoate of, in swine plague, treatment with	10, 182
value of	182
borate, effect of, on development of swine-plague micrococcus	78
hyposulphite in swine plague, treatment with	10
Soils, certain, effect of wet seasons in swine plague	133
Soils, particular, dry seasons on, dangerous in swine plague	132
South Carolina, condition of farm animals in	365
Southern cattle fever	206
extent of losses from	207
Splenic fever in Missouri	325
Virginia	323
Spirillum	53, 55, 68
in mouth	56
Spirochæte	55
Spirochæte plicatilis in mouth	56
Spores of *Bacillus anthracis*, not destroyed by oxygen	119
Spread of swine plague	324
varies with virulence	189
Stage of colonization of swine plague	191
Strepto bacteria	52
Strepto coccus	52, 58
Summer dangerous in swine plague, reasons for	132
Stephanurus dentatus in swine	17, 22
Strongylus elongatus in swine	17, 22
Structure, microscopic, of healthy lungs	272
Sulphate of potassium and boracic acid, effect of, on fowl-cholera virus	32
quinine, antiseptic influence of, upon swine-plague virus	8, 26
quinine, effect of, on development of swine-plague micrococcus	78
Sulphuric acid, effect of, on fowl-cholera virus	32
Suffocated pig, inoculation with blood of, in swine plague	145
Suggestion, important, concerning contagious diseases	324
Supposed causes of anthrax among cattle in New York	313
Susceptibility to fowl cholera increased by cold weather	40
Swine, diseases of, extract from President's message concerning	231
Echinorynchus gigas in	17, 22
fever among foreign animals landed in Great Britain	217
hogs condemned for, in Liverpool	204
landed in England	209
plague, a bacteridian infection	83
a contagious disease	13
antiseptics in, value of	181
arrested by carbolic acid	10
bacillus in	16
bacterium of	8
identical with virus of	8
Bacterium termo in	16
benzoate of soda in, value of	182
carbolic acid in, value of	181
treatment of, in herds	174
close drains objected to in	131
closed spaces beneath floors to be avoided in	130
communicated by inoculation	13
contagion of	65
crowding animals in confined spaces in, to be avoided	130
danger from market yards in	131
railroad buildings in	131
cars in	131
vessels in	131
definition of	154
differences of observations, explanations of	67
difficulty of securing virus of	7, 8

Page.

- Swine plague, Dr. Law's experiments with 10
  - Dr. Salmon's investigations of 13
  - dry seasons in particular soils dangerous in 132
  - dust a cause of 321
  - effect of wet seasons on certain soils in 133
  - experiments in 164
    - progress in 115
    - results of 178
  - germ, chemical products of, influence of 135
    - mitigation of virulence and fatality of 117
    - virulence decreased in free air 117
      - increased by limited air supply 117
  - herding animals in, to be avoided 129
  - immunity from, produced by first attack 183
  - in other animals 184
  - infected herds, inoculation of 135
  - infection, exposure to, comparable with inoculation with minimum quantity 113
  - infectious principle of 184
    - not bacteria, but schizophytæ 185
  - inoculation of infected herds 135
    - with blood of suffocated pig in 145
    - with devitalized blood in, advantages of 144
      - disadvantages of 145
    - precautions to be observed 144
  - insusceptibility to, induced by products of growing germ of 10, 117
  - investigation of, Dr. Law's 80
    - third, of Dr. Detmers on 113
  - iodine in, value of 182
  - laurel a cure for 321
  - lesions definitely ascertained 13
  - liquid manure pits, objection to, in 131
  - loose dry earth as disinfectant in 133
  - measures of prevention of 192
  - micrococcus of 25
    - development of, effect of benzoic acid on 78
      - borate of soda on 78
      - carbolic acid on 77
      - heat upon 79
      - iodine on 79
      - quassia on 79
      - salicylic acid 79
      - sulphate of quinine 78
      - zinc chloride on 79
    - effect of carbolic acid on vitality of 77
      - disinfectants upon 25
      - inoculating urine with 76
  - morbid changes in 156
    - process of 190
  - nature of organism causing 8
  - northern limit of, Illinois 7
  - not communicated, unbroken skin or membrane 180
  - object of Dr. Salmon's experiments in 13
  - possibly modified form of septic infection 115
  - post-mortem examinations in 158
  - preventive for 323, 325
    - experiments of Dr. Detmers with 10
    - inoculation with cultivated schizophytæ in 194
  - prognosis of 155
  - protection against, by mitigated type 81
    - by first attack, relative 90
  - protective influence of first attack of 83, 89
    - inoculation in 183
      - preserves disease germs 134
      - retards growth 134
      - with mitigated virus in 134
  - reinoculation hastens fatality 114
  - results of inoculations with cultivated virus in 18
  - schizophytæ of, disappear with appearance of *Bacterium termo* 183
    - development of, influenced by weather 189
  - spread of 324
    - varies with virulence 189
  - stage of colonization of 191
  - southern limit of 7
  - summary of experiments in 178
  - summer season dangerous in, reasons for 132
  - supplemental report on, by Dr. Law 116
  - symptoms of 155
    - definitely ascertained 13
  - treatment of 195
    - with benzoate of soda 10
      - hyposulphite of soda 10
      - iodine 10
  - uninoculated healthy pigs subject to 182
  - varying seasons favor varying mortality in 182
  - virus, *bacilli* in 66
  - virus, concentrated, maximum dose deadly 83, 89
    - cultivated, deadly 81

Page.
Swine plague virus, cultivated, general results of inoculations with 128
in cows' milk and free air, inoculations with 124
in egg albumen in free air, inoculations with 125
in human urine in free air, inoculations with 125
with exclusion of air, deadly 81
cultivation of, on slides 24
in test-tubes 25
danger of storing and increasing potency of 129
deadly character of 19
dried on quill, inoculations with 125
effect of chloride of zinc on 72
disinfectants on bacteria of 76
drying upon 16
putrefaction upon 15
quassia upon 26
inoculations with cultivated 113
deductions from 128
excess of 113
minimum quantity of 113
microscopic observations upon nature of 19
mitigation of 81
by artificial means 10
potency of, increased by putrefaction with limited air supply 115
large dose 83, 89
preserved in closed vessels, inoculations with 128
with limited supply of oxygen, inoculations with 126
primary, inoculations with 113
virulence and fatality of, increased by limited air supply 10, 123
of, diminished by influence of chemical products of growing germ 10
wood ashes a preventive for 325
and salt a preventive for 325
wooden floors objected to in 130
walls objected to in 130
Swine, *Sclerostoma dentatum* in 22
Stephanurus dentatus in 17, 22
Strongylus dentatus in 17, 22
symptoms of foot and mouth disease in 285
Symptoms of acute bronchitis 233
anthrax among cattle in New York 313
foot and mouth disease in birds and fowls 264
cattle 283
horses 285
sheep and goats 285
swine 285
fowl cholera 41, 70
swine plague 155
definitely ascertained 13
Texas cattle fever 291
Temperature, atmospheric, influence of, on body temperature 80
Tennessee, anthrax in 322
condition of farm animals in 366
Texas cattle fever, experiments with 294
microscopic investigation of 294
morbid changes of 292
origin of outbreak of 294
symptoms of 291
Theories of contagion, influence of recent investigations upon 48
how established 49
Theory, bacteria 51
caution concerning 60
how established 61
of bioplasm or its granules 50
of unorganized ferments 49
Tissues, bacteria in, not injurious to health 58
Toussaint's experiments in protective inoculation against charbon 303
in protection in anthrax by devitalized blood 141
mitigated virus 62
Transformation of *Bacillus subtilis* to *B. anthracis*, and *vice versa* 118
Treatment, carbolic acid, of swine plague in herds 194
medical, of contagious diseases 69
fowl cholera 71
of swine plague 195
preventive of fowl cholera 71
Tubes, capillary vacuum, method of making 22
Type, mitigated, of swine plague 10
for protection against second attack 10
Typhoid fever, example from, on influence of limited air supply on disease germs 122
Undetermined bodies in fowl cholera 48
Uninoculated healthy pigs, subject to swine plague 182
United States, animals from, landed at Liverpool, statistics of 204
extent and location of pleuro-pneumonia in 204
Unorganized ferments, theory of 49
Utah, condition of farm animals in 370
Vaccination of contagious diseases 69
Vacuum tubes, capillary, method of making 22
Ventilation, easy destruction of contagium by 60

Page.
Ventilation, efficient means of disinfection 18
Vermin, intestinal, hog cholera, so-called, often due to 143
Vermont, condition of farm animals in 370
Vessels, dangers from, in swine plague 131
Veterinary department of the privy council of Great Britain, annual report of 209
Virginia, condition of farm animals in 371
    splenic fever in 323
Vibrio 53, 55
Virus, devitalized, as preventive against fowl cholera 36
    dilution of, effect of 89
    fowl cholera, antiseptic effect of benzoic acid upon 31
            boracic acid upon 33
            boracic acid and sulphate of potassium upon 32
            carbolated camphor upon 32
            carbolic acid upon 33
            iodine upon 33
            salicylic acid upon 31
            sulphuric acid 32
        cultivated, preservation of 39
        difference in nature of, and septic organisms 32
        effect of alcohol upon 32
            dilution of 30
            drying upon 30
            heat upon 33
            putrefaction 30
            when taken with food 29
        identical with bacteria 9
        influence of antiseptics upon 9
        mitigated, attempts to obtain 39
        not taken up and carried by air 9
        organs containing 28
        period of incubation of 27
        mitigated Toussaint's 62
        protective inoculation with, in swine plague 134
            drawbacks to 134
    of foot and mouth disease, vitality of 287
    septic, effect of inoculation with 94, 98
    swine plague, bacilli in 66
        concentrated, maximum dose deadly 81
        cultivated, deadly 81
            general results of inoculations with 128
            in cows' milk and free air, inoculations with 124
            in egg albumen and free air, inoculations with 124
            in human urine in free air, inoculations with 125
            with exclusion of air, deadly 81
            preventive effect of inoculations with 115
        cultivation in test-tubes 25
            of, on slides 24
        danger of increasing potency of, by storing 129
        deadly character of 10
        difficulty of securing 7, 8
        dried on quill, inoculations with 125
        effect of antiseptics upon 8, 25
            chloride of zinc upon 14, 72
            disinfectants on bacteria of 76
            drying upon 8, 16
            heat upon 8
            putrefaction upon 8, 15
            quassia upon 26
        inoculations with cultivated 113
                deductions from 128
            excess of 113
        miscroscopic observations upon, nature of 19
        mitigation of 81
            by artificial means 10
        modified, inoculations with 124
Virus of swine plague, potency increased by partial putrefaction with limited air supply 115
        of large dose 83, 89
    preserved in closed vessels, inoculations with 128
        with limited supply of oxygen, inoculations with 126
    primary, inoculations with 113
    results of inoculations with cultivated 18
    treatment with chloride of zinc, mode of preparing 14
    virulence of, diminished by influence of chemical products of growing germ 10
    increased by limited air supply 123
Virus treated with chloride of zinc, method of inoculation with 14
Virulence of blood after death in fowl cholera, period of 31
    swine-plague germ, decreased in free air 117
        increased by limited air supply 10, 117
        mitigation of 117
        spread varies with 189
        virus diminished by influence of chemical products of growing germ 10
Virulent agent of septicæmia 63
    matter, potency of increased 114

Page.
Vitality of swine-plague micrococci, effect of carbolic acid upon 77
    virus of, foot and mouth disease 287
Walls, wooden, objected to in swine plague 130
Washington Territory, condition of farm animals in 373
Weather, influence of, on development of schizophytæ of swine plague 189
Weeds poisonous to cattle 321
West, non-existence of foot and mouth disease in 319
West Virginia, condition of farm animals in 374
Wet seasons, effect of, on certain soils in swine plague 183
Wharves, foreign animals in England 215
Wheat bran, virulent matter increased in potency by packing in 114
Whitney, Dr. W. F., examination of lungs of pleuro-pneumonia 272
Wisconsin, condition of farm animals in 373
Wood ashes a preventive for swine plague 325
    and salt a preventive for swine plague 325
Wooden floors objected to in swine plague 130
    walls objected to in swine plague 130
Worms, earth, bearers of germs of charbon 307
Yards, market, dangers of, in swine plague 131
Yellow fever, argument from, on influence of limited air supply on disease germs 129
Zinc chloride, effect of, on development of swine-plague micrococci 79
    influence of, upon swine-plague virus 8, 14, 26, 72
Zooglœa 52

LANE MEDICAL LIBRARY

To avoid fine, this book should be returned on or before the date last stamped below.

Y181 U.S.Dept.of Agriculture.
U6 Contagious diseases of
v.2, domesticated animals.
1881 8976

NAME	DATE DUE